

Energy, pollution and climate change: the challenge of addressing global public goods.

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The individual must not merely wait and criticize, he must defend the cause the best he can. The fate of the world will be such as the world deserves¹.

The IPCC 5th Assessment report will soon be completed. It will confirm –based on enhanced scientific grounds- the link connecting anthropogenic GHG emissions, the warming of the planet and long lasting consequences on climate change highlighted in the previous Report. Several causes are analysed within the IPCC Working Group 1 Report – including the atmospheric concentrations of carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) - yet the responsibility for this unsustainable development is mainly ascribed to the exploitation of fossil fuels.

Indeed, an intensive use of energy sources characterizes both the economic growth of industrial countries and the development of emerging areas of the 21st century². In the last four decades the global use of energy has more than doubled, albeit over 1.4 billion individuals still lack access to electricity³. Electricity constitutes an indispensable input for the production of all goods and services and for final consumption, while the use of energy for transportation grows at an exponential rate, as a result of the increase in global mobility and international trade volumes. As 80 percent of world energy is generated from fossil fuels and these are responsible for the majority of carbon dioxide emissions in the atmosphere, such a development imposes an unsafe burden to the balance of the global eco-system and, from point of view of scientists, constitutes a significant cause of the global warming⁴. Environmental imbalances therefore are among the most inherent

¹ Albert Einstein, “The Russell-Einstein Manifesto,” London, July 9th, 1955. The manifesto was issued as a call for a nuclear disarmament and went on to be one of the founding documents of the Pugwash Conference on Science and World Affairs.

² The global primary energy consumption doubled between 1971 and 2008. International Energy Agency, World Energy Outlook 2012.

³ As related by the International Energy Agency (IEA), today some 1,441,000,000 individuals still have no access to electricity. Perversely, this entails significant consequences for the growth of emissions due to deforestation and the burning of organic matter. World Energy Outlook (henceforth: WEO) 2012.

⁴ Energy has a disproportionate impact on the emissions of carbon dioxide, estimated by the IEA as 82 percent of the global OCSE countries emissions and 59 percent of the emissions of the rest. The trend is starkly growing since the end of the past century (the share was estimated in 33 percent for 1990) and is caused by a host of challenging factors, such as the rapid growth of emerging countries (particularly China and India) and the intensive use of fossil fuels among primary energy sources. Among the latter, coal accounted for an emission growth of over 70 percent between

contradictions of the capitalistic mode of production, adding to the potential restraints caused by the unequal distribution of income and wealth and the economic and political instability.

The awareness of this problem first arose and began spreading over thirty years ago, with the publication of the report of the Club of Rome on the limits to growth (1972)⁵. Its real extent, however, was only grasped towards the end of the '80s, when in 1988 scholars and scientists from all over the world, gathered under the auspices of the United Nations in the Intergovernmental Panel on Climate Change (IPCC)⁶ and determined that the mid-21st century was the foreseeable threshold for the sustainability of the system. This limit was defined as the capability of the planet to correct the environmental unbalances and of the industrial countries to face the scarcity of primary energy sources.⁷

What are the prospects and solutions for the future? To what extent does atmospheric pollution, together with the use of scarce and polluting energy sources constitute a risk to the global system?

The answer is uncertain. History proves that innovation and technology can lead to outstanding leaps in production patterns, as well as to sudden changes in the organization of daily life, unforeseeable breakthroughs in social development. It also shows that mankind can co-ordinate and carry out actions on a global scale. This is testified by the recent example of the Montreal Protocol (1987), which led to the implementation of effective measures to mitigate the depletion of the ozoneosphere.

Processes leading to an environmental-friendly development can be governed; the dynamics of change, however, are intrinsically characterised by transitional problems where evaluating path dependency issues that can arise in the long term is a difficult task and make long term results

1990 and 2006. On a different front, deforestation accounts for some 15 per cent of the global emissions level. See International Energy Agency, *CO₂ Emissions from Fuel Combustion – Highlights, 2010*, p.18. For the trend of CO₂ emissions from fossil fuels, see in particular Figure 2.

⁵ Meadows D., 1972. An update to the report was published in 2004: *Limits to Growth: The 30-Year Update*, Chelsea Green Publishing Company.

⁶ In 1988 the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) established the Intergovernmental Panel on Climate Change (IPCC), to “provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts.” The IPCC published its First Assessment Report in 1990. The latest, Fourth Assessment Report, was published in 2007. See www.ipcc.ch.

⁷ It is estimated the warming of the planet needs to be stabilized at 2 °C. In the absence of immediate corrective actions, the likelihood of an increase of 5 °C—incompatible with the eco-system—is estimated at 50 percent. This probability decreases to 3 percent in case a ceiling of 500ppm to CO₂ emissions is imposed, as provided by the Bali agreements of 2007. The costs associated to this measure are estimated in 1-2 percent of the global GDP in the next 20 years, whereas the costs of inaction are estimated in over 5 per cent (ranging from 5 to 20 percent) of the global GDP, in terms of forfeited growth. The goal of limiting the warming to 2 °C was restated in the agreement reached in Copenhagen in December 2009. However the measures announced after Copenhagen do not appear to be sufficient to reach the stated goal. Other estimates focus on the limited availability of primary energy sources, particularly of oil, expected to reach the peak of its available supply in the next few decades, highlighting the need of a suitable substitute. On this aspect the debate is still open. See L. Maugeri, *Con tutta l'energia possibile*, Sperling e Kupfer, 2008.

uncertain. Even trickier is the task of assessing to what extent countries characterised by different cultures, histories backgrounds and economic development weigh the risks, the costs and benefits of change, and so allow for a co-ordinated action. The different attribution of these weights further thwarts globally coordinated policies.

It is possible to envision that in the long term these “limits to growth” can be overcome thanks to the discontinuities generated by technological progress applied to production processes and innovation in lifestyles. The spread of innovative technologies is thus the key to propel industrial countries toward an environmental-friendly production system, leading to the adoption of new energy sources. Whereas the transfer of technology should bring emerging economies towards a development path that does not retrace the polluting course taken by their industrial predecessors, toward a new track of modernization, that shall be accompanied by values and lifestyles that respect the principles of environmental sustainability.

To this end, it is essential that new models do not encounter economic obstructions, but rather are met with the support and endorsement of the Western World. Governments and institutions have a central role in promoting and enabling change –e.g. by endorsing, co-ordinating and steering the search for different uses of energy sources⁸; the application of ICT in the public sector is another example, as this results in decrease in the need for physical mobility and allows for a more efficient and rational management of energy sources. Noteworthy is the introduction of so-called “smart grids” –i.e. the application of ICT to the energy sector-, enabling a more efficient use of renewable energy sources. These by nature are intermittent and unpredictable and distributed throughout the territory; this application allows the remote control of energy flows and further innovations in the field of electricity saving and storage.

Consequentially, the energy issue in its different facets is at once both a weakness in the current development of capitalism and a significant driver of innovation and growth. It can indeed encourage, with the help of institutional changes, the introduction and the spread of innovative technologies and a more sustainable organization of daily life.

The need for a shared global governance

At this point optimism must give way to the analysis and to considerations regarding current dynamics. In fact, this process of change requires ideas and tools, the co-ordination of the involved

⁸ In 1992 the Rio Conference adopted the UN Framework Convention on Climate Change (UNFCCC), which went in effect in 1994. During the 3rd COP (Conference of the Parties) held in Kyoto in 1997 the adoption of the namesake Protocol was decided, that entered in force in 2005. The Protocol provided for two phases, 2005-07 and 2008-12. During the 13th COP in Bali (2007) was resolved to implement a “Bali Roadmap” for the post-Kyoto period, that envisaged a two-year negotiation process to draft a post-2012 agreement to be implemented at the COP15/CMP5 in Copenhagen. In the Conference of Copenhagen the requirement of containing the global average warming increase under 2 °C—as compared to the pre-industrial period—was restated, and it was provided for a 30bn \$ funding for the period 2010-12, whereas a dedicated UN fund was to be endowed with 100bn \$ per year by 2020. These funds are to be allocated to the more vulnerable countries to help them to absorb the impact of climate change. The Kyoto Protocol provides for binding goals for 37 industrial countries and to the EU with the aim of decreasing GHG emissions by 5.2 percent on average—against a 1990 baseline—in the period 2008-12.

actors, a suitable institutional framework, while the stumbling blocks to overcome in its progress are many.

The first hurdles are within the scope of the economic discipline that does not yet offer adequate analytical tools and policies to deal with global public goods —such as the protection of the planet. Other obstacles are within the sphere of the international institutions that still lack legitimacy and a suitable organisation. Further difficulties are in the priorities imposed on the political agenda in international negotiations forums by countries that have a key role in steering the negotiations on climate change that answer to markedly different models of governance and—this has been the case of the US, the E.U. and China, among others.

This paper concentrates on the issues described above, which have hindered the capacity of Governments to cooperatively lead the process of change in order to overcome the apparent trade-off between economic growth and environmental sustainability and highlights the need for further analysis and study.

- Firstly, economic theory does not yet offer a suitable conceptual framework for the management of global public goods that accommodates both efficiency and equity considerations. Such framework would help to define how to finance the cost of decarbonisation and establish shared criteria for burden sharing among regions.

From a purely theoretical perspective, it is time to accept that the issues associated with the conservation of the planet cannot find all the answers needed within the micro-economic framework and the analysis of optimizing behaviors of producers and consumers. Environmental conservation falls within the instances of market failure that require Government intervention; still, analytical tools available to economists for the investigation of territorial public goods are hardly applicable to global public goods, such as safeguarding the planet and preserving a clean atmosphere⁹.

- The second set of obstacles is linked to the strategy to be followed. The difficulties in establishing global negotiation forums that are able to promote global co-operation agreements and guarantee their enforcement appear to be insurmountable. Even regional perspectives face diverse models of social and economic government which correspond to disparate stages of industrial development. Flexible policies are undoubtedly advisable and the same is true for the direct involvement of interested stakeholders -citizens and enterprise alike- in the dialectics

⁹ On the other hand, economic theory does provide a powerful tool to overcome the restraints imposed by the scarcity of fossil fuels (oil, coal and gas). Changes in relative prices, through free market, should guarantee in time the substitution of primary goods—as they become scarcer and thus more expensive—with more affordable ones, engendering a process that would lead to their overall replacement in the mid- to long-term. Developments in the past few decades and a number of studies, however, emphasise how such a scenario is not realistic for the energy sector. This option is challenged in a number of studies on the energy sector, notably by Dosi and Grazzi, that conclude: “Despite the theoretical inclinations of the economists, the notion that changes in relative prices may induce substitution among inputs—in particular between energy and capital—tend to be a far-fetched idea with little empirical support. The general case is, on the contrary, that of a complementary relation between energy resources and manufactured capital.” G. Dosi, M. Grazzi (2006). The same conclusion is shared by Landes D.S., *The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present*. Cambridge University Press, Cambridge 1969. See Figure 3, Trend in the World Consumption of Oil and Prices.

which should be founded on a mixture of measures—known in negotiation jargon as “top-down” and “bottom-up”.

- Finally, the third obstacle concerns the limits of international institutions. Common solutions must be identified and coordinated on an international level, however international institutions lack the legal and fiscal powers required for consequential implementation. This is entrusted to States and local governments, which in turn are characterized by different models of governance and stages of development and dispose of diverse tools. It must also be highlighted that governments—especially at a local level—respond to a plurality of stakeholders, both public and private, endowed with different “voices”. This diversity cannot but produce dissimilar outcomes on the regional level. The last decades show that it is no easy task to enforce cooperation and convergent strategies on such diverging grounds.

These three dimensions, though described as obstacles to finding a common strategy, can also demonstrate the potentials of economic growth inherent to the cogent need to jointly address the energy problem, pollution and global warming.

For such a change to be effected both an analytical and a political path will be necessary. These will enable to adapt the different theoretical assessment tools and to integrate aspects of diverse governance models, in order to identify shared, participated and flexible responses to the challenges of climate change.

Economic theory and public goods

The first issue to be addressed concerns limits to economic theory, or rather to the tools economists dispose of in dealing with issues concerning climate change and coordinated action.

Preserving the balance of Earth’s atmosphere by containing greenhouse gas emissions is evidently a public good, or a product—as observed by Adam Smith (1776)—“which though may be of a great advantage to society, requires State intervention because profits deriving from its production could never repay the expenses and therefore do not provide for an adequate supply”¹⁰. Despite the evolution of the economic thought on this issue, we still do not have robust analytical tools nor a complete conceptual framework to deal with global public goods, nor adequate policy prescriptions to address the issue of the environmental sustainability of global growth.

The core of this commentary is based on the supposition that the prevention of gas emissions to limit anthropogenic consequences on climate change sharply differs from the traditional category of public goods due to its global scope, to the longer, intergenerational time-span, to the uncertain outcome of its production and of policy measures, which invalidate traditional evaluations based on cost benefit analysis and policy tools, elaborated within the theory of public choice. Its management involves historical responsibilities, criteria of justice, regional development and future growth: it is more complex and more challenging to govern, than what an efficiency-based paradigm would imply. In this respect, it is useful to recall the basic difficulties dealt with by the original theory of

¹⁰ Smith A, (1776) *Inquiry into the Nature and Causes of the Wealth of Nations*, Oxford University Press 1994, pp 779; cfr. R. Musgrave, P.Musgrave (2003 p.xii).

public goods and its recent development, to then offer a brief overview of the critical issues that still need to be addressed when dealing with these special global public goods, such as the protection of the planet and the sustainability of economic growth.

As it is well known, public goods are identified as the composite set of goods —national defence, justice to street lighting—that are “non-rival and non-excludable,” namely the use of the good by one individual does not reduce its availability to others and other individuals cannot effectively be excluded from the benefits thereof¹¹. The additional consumer of clean air, for instance, does not limit or hinder the consumption of such good for others. On the other hand, it is impossible to limit access to clean air through rules or market-based instruments. As a result, the market cannot assure efficient resource allocation for the production of public goods, as consumer preferences cannot be discerned from the prices individuals are willing to pay for its use. Conversely, interested parties are led to behave as free riders¹², namely to let others pay for the production costs of public goods, as they are certain to enjoy benefits without bearing costs. Clearly, this can entail an insufficient level of supply of the public good in question.

As a consequence, the task of providing an adequate supply of public goods was entrusted—both in theory and in experience—to the State which, on account of its legislative and coercive powers, can dictate its decisions and finance them through tax revenues¹³.

Marginalist economic theory addressed this problem of public choice -namely, the decision of which, among the possible public goods, is to be produced and in what amount- with the same principles used for private goods, basing their investigation on the tenets of the maximisation of individual utility. Thus, it was suggested that the efficiency benchmark ought to be defined by the marginal balance of costs and benefits¹⁴.

On this basis, at the outset of last century the issue arose of finding the best balance between the scope of the government and that of the market¹⁵. The theoretical debate focused on the issue of

11 Definition of public good. Stiglitz V.J., “The Theory of International Public Goods and the Architecture of International Organizations,” Background Paper No. 7, Third Meeting, High Level Group on Development Strategy and Management of the Market Economy, UNU/WIDER, Helsinki, Finland, July 8-10, 1995, p.1. Francesco Ferrara (1850). Musgrave R., *The Theory of Public Finance*, McGraw Hill, NY 1959. Olson M., *The Logic of Collective Action*, Harvard University Press; Cambridge Ma 1965; Buchanan J., *The Demand and Supply of Public Goods*, Rand Mac Nally, Chicago 1968 .

¹² See, among others, Sandler T., “Assessing the optimal Provision of Public Goods: in Search of the Holy Grail,” p. 132. in I. Kaul, P. Conceição, K. Le Goulven, R.U. Mendoza., *Providing Global public Goods*, Oxford University Press, New York 2003.

¹³ Cfr.Artoni R, *Lezioni di Scienza delle Finanze*, Il Mulino, Bologna 1999; Stiglitz J., *Economics of Public Sector*, Norton & Co., New York 2000.

¹⁴ Later, Samuelson (1954) illustrated a basic feature of public goods, namely that the marginal rate of transformation of production should be equal to the sum of the consumers’ marginal rate of substitution among goods. At the equilibrium, the production cost of a marginal unit of a good corresponds to the marginal rate of substitution. Samuelson supposed independent utility functions, and his social welfare function allows to combine the marginal utilities or the marginal rate of substitution among individuals. However, it was noted that this makes his solution “ineffectual for any economic policy measure”. Desai (2002, p. 71).

¹⁵ As remarked by Musgrave, in R. Musgrave, P. Musgrave, “Prologue,” in *Providing Global Public Goods*, I. Kaul, P. Conceição, K. Le Goulven, R.U. Mendoza (eds.), Oxford University Press 2003.

how the State, in its capacity of a benevolent absolute ruler, might assure—efficiently, democratically and in exchange for the payment of taxes—the citizens welfare through the direct provision of public goods or, similarly, through measures to limit “public harms,” defined as negative externalities¹⁶. The issue hinged on the possibility of identifying and revealing the preference of the citizens among alternative public goods and of establishing an equitable and efficient distribution of the costs of the related measures. Since in the case of public goods, such as clean air and national defence, consumer preferences are not revealed through the price mechanism, Wicksell deferred to the public arena the task of defining the choices of the consumers of public goods by means of the ballot, a tool that allows for an implicit comparison between costs (expressed as taxes) and benefits for the citizens¹⁷.

The issue of pricing negative externalities, namely to ascribe a cost to undesirable consequences of consumption or production, was solved by Pigou (1920) by means of levying a tax to internalize the social cost of negative externalities. In the case of CO₂ emissions, for instance, a carbon tax would solve cost imputation of emissions to the general burden of producers and/or consumers.

Coase (1960) later proposed to bring public goods back into the scope of private contracts and to disentangle the State from their production by means of clearly-defined property rights, that enabled individual actors to privately trade and monetize such rights. Today this category includes the emission rights of CO₂ into the atmosphere, by virtue thereof a price is established for a negative externality (in this case, CO₂). As these emission rights are tradable, exchanging them on the market should create a price based on demand and supply by producers and consumers of a pollutant. These actors could thus optimise their choices by paying the market price of CO₂ emissions.

This seemingly straightforward mechanism, however, presents a series of issues. In the first place the market price is determined by the amount of emission rights that the relevant authorities choose to make available to the market on a particular territory. Secondly, the initial allocation of such rights is often made free of cost to prevent distortion of competition, they may be otherwise auctioned off in compliance to market rules, with disparate consequences for the system as a whole. Furthermore, these allocation mechanisms assume that the amount of emissions by different plants, companies or industries may be measured in a reliable and certified fashion. Last but not least, while this tool could be effective in a competitive market, its application to oligopolistic energy

¹⁶ The theoretical contributions by Wicksell (1894), Lindahl (1919), Wagner (1888), Pigou (1920) and the earlier works by Francesco Ferrara (1850) summarize the better-known positions in the confrontation between the Swedish-, the Austrian- and the Italian Schools. Cfr. Pigou A.C. «The Economics of Welfare», Macmillan, London 1920. Lindahl E (1919), «Just Taxation: A Positive Solution», in R. Musgrave, A. Peacock (eds.) Classics in the Theory of Public Finance, Macmillan, London 1958. A. Wagner, (1888) «Three Extracts on Public Finance», in R. Musgrave, A. Peacock (eds.), Classics in the Theory of Public Finance, Macmillan, London 1958.

¹⁷ Wicksell K. (1894), A New Principle in Taxation, in R. Musgrave, A. Peacock (eds.), (1958). In the case of collective goods (non-pure public goods) the efficient solution is different. Such goods bring about conditions of congestion or overcrowding, such as the access of any additional consumer decreases the benefits for the previous users of the good. For such goods it is possible to set a toll (for instance, to cross a bridge) or a fee or tariff (to access satellite TV or electricity networks), since in this case the non-rivalry principle—that makes the cost of additional use equal to zero—is not entirely fulfilled. Similar considerations are relevant in the case of goods characteristically labelled “club goods” by Buchanan (1968). For such goods Buchanan envisioned the standards for an efficient supply—such as a hunting or fishing permit—for a limited group of users, without the recourse to government.

producers, which are able to transfer the price of CO₂ to final consumers cancels out any potential effect of reducing CO₂ emissions and potentially generates windfall gains for energy producers and financial intermediaries: indeed, this scenario very much corresponds to the result of the European Emission Trading System (EU ETS), a decade after its launch.

The nature of global public goods

The theoretical framework illustrated above goes into disarray when the provision of public good crosses the borders and the scope on the nation-State. In fact, the nature of global public goods, defined as “goods whose benefits extend to all countries, people, and generations”¹⁸, makes the task of finding solutions based on the above-mentioned assumptions and models quite problematic.

There are at least three conceptual problems worthy of note:

- a) Analysis based on the comparison of costs and benefits is employed for investment decisions. It supposes that people are able to evaluate and quantify *ex ante* the results and consequences of their choices. However, this requires inter alia a defined timeframe for the implementation of the investment in question. In the realm of energy and climate change, where the expected benefits are uncertain and distant and markets are imperfect as a rule, these premises are unviable.

Moreover, criteria to identify the efficient supply of a public good based on directly balancing the expected costs and benefits require that the relevant reference groups (those who makes a decision and those who are affected by it) are defined, that the area impacted by the externality is limited and that the responsible government level is known. Conversely, when analysing the possible solutions to contain the emissions of greenhouse gases on a global scale the definition of the interested groups is problematic and, as the geographical scope of the issue crosses political borders, making it impossible to identify the Government actor endowed with the proper legislative and coercive powers.

A different, yet related, set of problems concerns the risk of producing perverse social macroeconomic results in a long run perspective, when the analysis is based on adding up optimizing individual behaviour.

- b) The second issue concerns the difficulties in entrusting collective decisions that impact future generations on individual choices, usually made based on expected income. The time

¹⁸ Kaul I, Mendoza R., Advancing the Concept of Public Goods, in UNDP 2003, p. 95. Under this respect, Sandler T. (in: Kaul I., Grunberg I., Stern M., Global Public Goods, Oxford University Press, 1999, p. 482) suggests to establish a UN Global Trustee Council to monitor the responsibility of collective choices that impact the future generations. “A club is a voluntary group deriving mutual benefit from sharing one or more of the following: production costs, the members’ characteristics, or a good characterized by excludable benefits.”, in Cornes R., Sandler T., The Theory of Externalities, Public Goods and Club Goods, Cambridge University Press, 1996, pp 33-34. Again, setting the limits of the reference group encounters insurmountable hurdles in a global setting. See also G. Heal ’97 UNDP; N. Stern 2009; S. Barrett 1999, p.204.

span coincides with the long term and hence poses intergenerational problems. The timeframe, in other words, transcends the time of the decision maker. This makes establishing a discount rate with which to compare uncertain, distant benefits with current political costs extremely aleatory.

- c) Finally, the separation of the criteria of efficiency and justice that underpins the microeconomic foundations of the above-mentioned models cannot be viable in the case of global public goods, such as the mitigation of the hazards caused by climate change, that largely affect the poorest regions of the planet. Assessing the burden-sharing as to who must be called upon to contain negative externalities becomes difficult, if not impossible, within the public choice theory paradigm¹⁹. It is not to be taken for granted, as observed by Sen (2009), that solutions that fulfil the conditions of maximising the individual utility of the involved parties corresponds to the conditions that achieve the greatest social utility. For instance, in any negotiation that involves the greatest number possible of countries, to set forth from market-efficient solutions to establish afterwards the proper international actions to abate the CO₂ emissions and to deal separately with the compensation of the burdens is not a viable course of action. In an international setting the issues of efficiency and equity/fairness—understood as a fair distribution of the costs on the basis of previous responsibilities, benefits and sustainability of the burdens—must be dealt with concurrently to implement a course of voluntary co-operation.

In sum, any economic model that grounds individual decisions on cost-benefits analysis can orient the choice of an individual actor between alternative specific investments, time-limited and characterised by clear-cut expected yields and costs, in a domain of quantifiable uncertainty and risk. Such models, however, do not offer any theoretical support to political decision-makers tasked with making choices on negative externalities, against a backdrop of variable involved parties, vaguely defined geographical and political boundaries of the relevant area, and very long-term macroeconomic consequences. These choices have a long-lasting impact, involving future generations and considerations of fairness and justice and set the foundations for the future growth with significant implications for the development models for the succeeding generations²⁰.

¹⁹ To envisage solutions in two stages—inherent in a number of theoretical recommendations authoritatively mentioned, among other, by Tirole. Tirole (2009) criticises the course of climate change negotiations, basing his argument on a supposedly universal assumption: “a basic principle of economics—the optimality of maximizing a pie and then sharing it,” p. 3 and p. 20. On this basis, states Tirole, an efficient agreement requires consistent prices to bring about the desired behaviour in the substitution of primary energy sources and in the experimentation of technological innovations, as well as in the sanction of those who disattend their commitments. That this course of action is unviable in the global climate change negotiations that involve voluntary measures by countries characterised by disparate development levels and in the absence of a supra-national institutional framework that guarantees the commitments and impose sanctions is deemed a negligible objection.

²⁰ Of course, this is not to deny that—once the macroeconomic and social choices are made and the macroeconomic goals are established—specific models based on utilitarian standards and on a cost-benefit analysis can be fruitful to identify specific actions to nudge in the desired direction the individual economic actors, allowing them to assess their consumption and investment choices on the basis of the expected utility in the relevant time frame.

Undesired consequences of actions based on microeconomic models

Despite the above-mentioned issues, in the last few decades the standard procedure was to implement macroeconomic measures based on microeconomic principles of efficiency, disregarding institutional settings and the structure of the market at which they were targeted. It is thus useful to briefly exemplify how such measures have led to distorted—or even perverse—effects.

Europe and the United States, in particular, are marked by a discontinuity between the end of World War II and the 80s, on one hand, and the years between the 90s and the crisis of 2008 on the other.

During this period economics fostered, and later underpinned, a paradigm change that inverted the priorities also in the energy sector. Whereas in the early post-war period energy security was deemed a public good of prime concern, this was later superseded by the goal of “market efficiency” that became the cornerstone of public policy decisions after the ‘90s. The focus of economic analysis shifted from the regulation of State monopoly or oligopoly markets to “economic efficiency” of public decisions²¹. The logic behind these monopolies under governmental ownership or management consisted primarily in the belief that utilities were responsible for providing the public with a secure supply of energy and should leverage on the contractual strength of the public monopoly.

The reference models employed, such as the macroeconomic analysis of long-term investments and infrastructure in imperfect markets, became inspired by tools from microeconomic analysis. As such, they aimed at establishing allocation efficiency and *short-term equilibrium*, at the margin, in *free markets*, where State intervention is absent²².

The macroeconomic consequences in the energy sector offer a few clear examples of how unsolicited long-term consequences can prevail over the positive impact anticipated by theoretical models when we are in the presence of complex environments that cannot be reduced to a model that aggregates the optimising behaviours of individual actors²³.

A clear example of this prevalence is represented by the introduction of the tradable emission rights of greenhouse gas emissions adopted by the European Union in 2005. The logic behind that scheme was to internalize the costs of carbon dioxide (CO₂) emissions for the community while at the same time encourage innovation both in the generation technology and in the consumption patterns of energy. The undesired outcome was the rise of windfall gains for large generation companies of electricity operating in oligopolistic markets, which were able to pass the increased costs of CO₂ emissions to their customers in the form of higher prices. This was accompanied by the profits accrued to financial brokers who speculated on the volatility of prices of tradable emission rights,

²¹ Under this respect is the observation by North that in contrast with this notion North supports the concept of dynamic or adaptive efficiency, that evolves with the changing technological and demographic setting. See D. North 1990.

²² The European experience in the evolution of the EU Commission Directives on the issues of energy and climate change since the 90s is a clear instance of this changed perspective.

²³ See, for instance, on the European energy policy, Helm D., “The Assessment: the new energy paradigm,” Oxford Review of Economic Policy, vol. 21, n.1, 2005.

even finding financial opportunities in new means of fiscal arbitrage²⁴. The desired impact on emissions has yet to come about.

The missed target, in this case, can be mainly ascribed to the introduction of an instrument designed for free, competitive markets in an oligopolistic market. This generated effects on the system — unanticipated by reference microeconomic models— which stemmed from defensive behaviours of electricity generation companies and energy-intensive industries and from price volatility caused by the speculation that generally occurs whenever the adjustment of real variables is deferred to financial tools.²⁵

A second example can be found in the application of analytic tools, mainly consisting in the containment of the short-term operating costs, to achieve efficiency in the electricity market during the liberalisation process. From the '90s onwards, indeed, a number of wholesale electricity exchanges were established to encourage the development of competitive markets in the energy sector. These provided for electricity wholesale for new entrants on a purchasing and selling platform.

In most European countries, Italy included, the Anglo-Saxon model prevailed. This focused its efforts on the establishment *ex novo* of wholesale markets for electricity and in some cases (such as in Italy) in the fragmentation of the dominant producer. An alternative path, followed by the Nordic countries in the early '90s, saw the liberalisation process accompanied by the actual broadening of the market, as national electricity networks were interconnected through significant investments in cross-border transmission networks and infrastructure.²⁶

Consistently with the Anglo-Saxon theoretical framework, instead, many European countries, Italy included, focused their attention on establishing the marginal cost of electricity in the newly-created wholesale market achieved by means of operative mechanisms (e.g. marginal auctions) favouring the convergence of the wholesale price to the marginal cost.²⁷ Alongside the anticipated *short-term*

²⁴ See V. Termini, “Do polluting firms get paid for polluting? The EU Emission trading scheme: critical aspects in the Italian perspective”. Acts of the international meeting Regulation and Liberalisation, International Perspectives, Scuola Superiore dell’Economia e delle Finanze and John Cabot University, 26-27 October 2006, Rome, Italy.

²⁵ The European Emission Trading Scheme was put in place by Directive 2003/87/CE and went into force on January 1st, 2005. This scheme saw the participation of 15 Member States, despite the unavailability of national registries to allow the relevant transactions. In the first year of operations 362 millions tons of CO₂ were traded for a value of 7.2 bn euros. The price of emission rights reached up to a peak of 30 euros/ton, to drop to 10 euros/ton in May 2006 and eventually to collapse to 0.1 euros/ton in September 2007, when it became clear that the amount of tradable rights allocated to the market was excessive due to the overestimated forecasts in the plans submitted by the several Member States (Germany, in particular, was singled out for her submission). In the first phase (2005-2007) CO₂ emissions not only did not decrease, but actually increased by 2%. In the second phase (2008-2012) prices were around 22 euro/ton in 2008, to drop to 13 euros/ton in 2009 for similar reasons to Phase I. For Phase III the Commission suggested a number of corrective measures, including placing a price on the initial offer of emission permits, as opposed to the practice in the previous phases.

²⁶ See, for a reflection on the Nordic’s Nord Pool, V. Termini and L.Cavallo, “Spot, Bilateral and Futures Trading in Electricity markets. Implications for stability,” FEEM, n. 19, 2007 and Cavallo L., Sapio S., Termini V., “Market design and electricity prices: evidence from Nord Pool and California price crises.” XXI Jornadas de Economía Industrial, Bilbao, 8-9 September 2005.

²⁷ It is worth noting that shortly thereafter Britain abandoned the centralised Electricity Pool of England and Wales, established in 1990, replacing it in 2001 with a decentralised trading system, the NETA. Moreover, during the changeover period a number of significant adverse events in the co-ordination of operations and in regulations

outcome consisting in the short term electricity price reduction for consumers, a highly unwelcome effect arose investing the *long-term* equilibrium of the sector. As the price approached the marginal cost, little room remained for recognition of investment costs to generators —particularly in the case of sunk costs—with the consequence that investments swiftly decreased. A contraction of both public and private infrastructure investments was in part also due to the new uncertainty regarding future regulation measures, deeply undermining the stability of this sector and the investment capabilities of the producers.

The European experience in the energy sector shows the complexity of transitioning from a microeconomic to a macroeconomic setting and the challenges that arise when solutions that appear efficient in theoretical paradigm are translated into policy approaches disregarding considerations of path dependency and the complexity of market behaviour.²⁸

More generally, economic theory does not offer a framework to deal with global public goods. Similarly, the theory of collective goods (the “commons”), developed in the last few decades by Elinor Ostrom and her school, proves of little help in the case of global public goods. Undoubtedly, this theoretical approach is of great contribution to analyse the organisation and collective management of limited natural resources (fisheries, grazing lands, exhaustible water resources) on a local level, with the due participation of users²⁹ while enriching our understanding of the notion of institutional negotiation at a global level. The intrinsic global reach, however, in the case of global public goods blurs which variables to include in the model.

If the goal is to achieve a sustainable development, or rather to ensure development for future generations without compromising the current development potentials, instead of turning to theoretical frameworks based on accounting considerations, a more fruitful approach would be to avail ourselves of models that encompass institutional developments and take social values into account. The theoretical proposals advanced by Sen in this regard,³⁰ for instance, offer conceptual tools more suitable to the choices we must make.³¹

To this extent economic policies must be founded on an approach that is both flexible and multi-dimensional, that transcends the theoretical sphere of public choice theory or that of a cost-benefit analysis to address socio-economic relationships. This must be framed by an adequate understanding of the institutions that embrace the development levels of the involved countries as well as the needs of the political negotiations.

occurred (Italy in 2003, California in 2001, New York City in 1977) that emphasised the inherent hazards of black-out and of disruptions in the electricity supply of the adopted model.

²⁸ As recalled by A. Giddens (Ch. 9), in different settings the EU offered a model for integrating and liberalizing trade in several areas. Trade areas as different as Mercosur (Latin America), NAFTA (USA, Canada, Mexico), ASEAN (South-East Asia) took a leaf from the European book. Russia, however, made recourse to traditional kinds of power to limit the EU’s influence in its neighboring countries, leveraging her oil and gas resources and dividing the EU by means of bilateral agreements. A.Giddens, *The Politics of Climate Change*, Polity Press, Cambridge UK 2009.

²⁹ Ostrom E., *Governing the Commons*, 1990, Cambridge University Press.

³⁰ Sen A., *The Idea of Justice*, Penguins Books Ltd, 2009

³¹ Rawls J., *Theory of Justice*, Harvard University Press, 1971. Cfr. also Stern N., 2007. The definition of sustainable development used by the Brundtland Report is to «meet[s] the needs of the present without compromising the ability of future generations to meet their own needs.»

Governance of processes and international institutions

The second challenge relates to jurisdiction. Whereas a plurality of actors play a role and have a voice in decisions relating to global public goods, only Governments are endowed with legislative and coercive power over the matter. The issue of jurisdiction concerns public decision making, but it is ever more crucial for the level of the implementation and financial support of measures. The principle of fiscal equivalence for which the decision level for a public good must be as close as possible to the domain impacted by the action, where its effects are felt and the burdens are established ³²(Breton 1965, Olson 1965, Oates 1972³³), is not pursuable on global public goods.

Responsibility for decision making does not only fall on State governments but is shared by stakeholders; these figures in turn tend to be fragmented and cross-border. Thus the distinction between the public and private spheres and investment becomes ever so blurred. If, indeed, the State once had responsibility over production, financing and distributing the cost of public goods, this is no longer true.

The State itself in this respect is further weakened within national borders by the increasing trend of decentralization and consequential fragmentation of the functions of the central State, granting mandates and functions to local governments, whereas on an international setting decision-making is influenced by several institutions and actors, also thanks to new means of communication used by civil society and in part by business interests and lobbies.

These tendencies have an impressive impact on the general concept of public goods. Towards the end of the last century the introduction of new technologies and increasing recourse to outsourcing have modified the terms of supply of several goods and services traditionally provided by public monopolies.³⁴ A key example can be found in the electricity sector, whereby liberalisation has led to the unbundling of the phases of generation, transmission and sales of electric power, profoundly altering the status of public monopoly of energy utilities. At the same time technological changes increasing the efficiency of decentralized regulation and renewable sources both entail an important organizational and regulatory review of the sector and make way for the creation and strengthening of more competitive markets.

As for the fragmentation of the participants, it is no longer possible to envisage a juxtaposition between the public sphere—embodied by the State—and the private one—represented by individual

³² The principle of fiscal equivalence, that underpins the principle of subsidiarity, provides that the range of the public good should correspond to the jurisdictional boundaries. In other words, that the beneficiaries of an action are involved in the decisional process and in the financing of the production of the public good, at the corresponding governmental level. For a critical discussion, see Breton 1965 and Desai M., “Public Goods: A Historical Perspective,” 2003, in I.Kaul et al.; Kaul, Grunberg e Stern emphasize – among the theoretical issues in the research in public goods – the importance of a lack of jurisdiction, participation, and incentives (UNDP 1999). On a similar vein see Scott Barrett (1999 e 2007).

³³ Olson M., *The Logic of Collective Action: Public Goods and the Theory of Groups*, Harvard University Press Cambridge Mass. 1972. Oates W., *Fiscal federalism*, Harcourt Brace and Jovanovich, NY 1972. Breton A., “A Theory of Government Grants,” *Canadian Journal Economics and Political Science*, 1965, 31, 2, pp.175-187.

³⁴ See, among others, G. Heal (1999), that emphasises the importance of market-based instruments to encourage the private supply of public goods. G. Heal, “New Strategies for the Provision of Global Public Goods: Learning from International Environmental Challenges,” in I. Kaul, I.Grunberg et al, 1999.

consumers and businesses. In political negotiations, in financial decisions and in the implementation of measures for the provision of public goods, both public and private actors are equally essential.

In the path towards a sustainable development only the intermediate goal can be global. This consists in the promotion of technological innovation in developed countries and the transfer of current technologies in developing and industrialising countries to encourage the transition to a new sustainable development model. A significant contribution to this goal can be provided at all government levels, calling for the active participation of civil society through the full range of organisational models, as it clearly emerges from the research by Eleanor Ostrom on the organization of common goods. The results reported in the Environmental Performance Index (EPI) further testify to the importance of a strongly participative economic model. This comprehensive scientific assessment of the environmental policies of single countries, compiled with the co-operation of a range of research institutes under the scientific direction of Yale University attests that countries that score higher for their environmental performance (European Nordic countries, Switzerland and Puerto Rico) are in fact those that have implemented participative policies.³⁵

The question remains whether a new and different global governance policy can be devised to contribute to the process of change at the international level.

Macro models of intervention

The interaction between these macro-models used at the national level to mitigate climate change proves an effective benchmark upon which to build a supra-national governance of the processes of change.

In the absence of a comprehensive supra-national framework, it has become necessary to establish a path that may be shared across the globe and that is founded on the voluntary adherence of governments. By analysing the negotiation table and the different courses of action established to deal with climate change, the approaches used may be categorized into three different models. These can be roughly associated to three different models of governance, each fruit of different historical backgrounds and institutions, not to mention drastically different levels of development, namely: the governance model of the European Union, of the United States, and the new governance model from China. Given the premises, the difficulties in conciliating these models into a single policy approach are quite comprehensible.

The European model

The action model advanced by the European Union corresponds to the institutional history of its Member States, in particular France and Germany, that most embody its approach. The reference

³⁵ EPI website <http://epi.yale.edu/>- 2010 Environmental Performance Index, Yale Center for Environmental Law and Policy, New Haven. The study builds an Environmental Performance Index through which around 163 are classified on the basis of 25 indicators relating to 10 environmental categories, pertaining to both human health and hygiene and to the vitality of the ecosystem. In this index greenhouse gas emissions and consequential climate change represent the component with the greatest direct weight, constituting around 25% of the x of the 25 indicators examined. On top of this, the weight attributed to indirect effects caused by emissions and by exposure to ozone may be added.

parameters stem from an established tradition of strong centralised States characterised by an efficient bureaucracy, both at a central and at a peripheral level. Hence, the measures identified to face the need of containing emissions are primarily “top-down”. The approach is centralised, based on the imposition of quantified and binding actions and on the commitments undertaken—unilaterally, if need be—in a global setting. Among these the compliance with emission standards by individual States, the centralised determination of the quota of primary energy consumption from renewable sources, of improvement in energy efficiency and energy savings, can all be mentioned as established on the basis of the parameters set by the EU bureaucracy. These measures constitute the 20-20-20 Plan decided by the EU Commission.³⁶

This approach, endorsed by the Kyoto Protocol, is the driver of EU policies though somewhat amended by the identification of flexible tools, such as Clean Development Mechanisms (CDM) and Joint Implementation (JI) projects. The parallel implementation of market-based instruments, such as tradable CO₂ emission rights, also determined centrally and allocated to the relevant industries on the basis of criteria established by the European Commission, does not significantly modify the model. The road map identified in Bali in 2007 to plan the course of the post-Kyoto (2012) phase still clearly reflects this approach.

For the same reasons, the European model stresses the implementation of multi-lateral negotiation forums to directly involve the participating States, preferably under the co-ordination of the United Nations. This enabled the negotiations within the UNFCCC (United Nations Framework Convention on Climate Change). It also helped to bring the vast majority of the countries of the world under the aegis of the Framework. Bali witnessed Australia—until then unwilling to sign any binding agreement—accede to the agreement and as the United States’ reluctance weaken under the Obama Administration. There is, however, a crucial qualification: in compliance with the established principle of burden sharing and proportionate commitments, industrialised countries (as per Annex I of the Kyoto Protocol) must pledge to implement binding measures to contain the growth of CO₂ emissions, whereas developing countries—such as China, Brazil, India and Indonesia for example—are exempt.

The American model

The American approach is entirely different: it grants a crucial role to stakeholders. In this it stresses the capabilities of trans-national businesses to lead towards change and innovation, grounds commitments and policies, being for emission containment or diversification of energy sources, on diffused incentives, promotes a bottom-up approach that largely circumvents centrally establishing commitments. The model encourages businesses to innovate, while committing to guarantee a stable and competitive framework. Accordingly, it endorses the use of market tools to promote energy efficiency and emissions restraint.

Such an approach embodies a distrustful attitude towards the capacity of supranational institutions, policy makers and international bureaucracies to centrally lead the process of change towards a sustainable path. However, it is particularly exposed to the organised lobbying of oil and energy companies, who may leverage on the decade-old proximity to the federal government.

³⁶ Dir 2009/28/CE of European Council, following the Commission’s proposal of “20-20-20 Package” approved in January 2008.

The Chinese model

The Chinese model, based on the well-established experience of a State to directly planning and controlling production and citizens lifestyle follows a centralised approach, with three significant qualifications:

- China does not tolerate external interference in national sovereignty, and therefore rejects binding burden sharing standards established by international institutions, even in the case of multi-national negotiations;
- it implements State and local government policies and massive investments to encourage innovation and technological change, aimed at environmentally compatible production.
- On the other hand it encourages State and private companies to operate to a global scale, acquiring rights to limited energy resources in exchange for financial and technological assistance and investments in infrastructure, following a sort of shared colonialism in the poorest countries, particularly in Africa.

China justifies its rejection of burden sharing within the UNFCCC by pointing out that binding commitments for all industrialised countries have yet to be established. Particularly in regards to the United States it advocates the principle of the historical responsibility and accumulated CO₂ stock in the atmosphere during the first industrial revolution. A principle that is shared by most high-growth countries such as India, Brazil, Indonesia and South Africa.

In terms of governance of international processes, these models correspond to different visions of national sovereignty and to the feasibility to entrust international institutions with mandates on specific shared targets. Whereas the history of the European Union makes mandates to international institutions a tolerable practice and charges such institutions with establishing guidelines to be implemented at the national level by States and local Governments, the same cannot be said for the U.S. Federal government, and is certainly incompatible with the Chinese model. These hurdles are particularly evident in a comparison between the effectiveness of the Montreal Protocol and the uncertain and unsatisfactory results of the Kyoto Protocol in terms of implementing the guidelines identified in the respective agreements. Whereas the former was immediately adopted—not least with unilateral measures—by the American Government, the second is still indeterminate in its outcomes, that must necessarily be achieved after a long chain of steps to be ratified by the different levels of government.

The distance between these models has created a series of rigidities in international negotiations, hindering the conclusion of shared agreements despite their clear advantages for all parties involved. More specifically, Europe must still support the growth of its businesses, the US might accrue great benefits from a multilateral negotiation approach (whereas it have insofar mainly relied on bilateral agreements with individual countries), and China cannot continue to disregard common commitments—that also touch on the commercial sphere—in order to achieve its goals.

The respective models could beneficially interact to find a common ground in a negotiation forum and thus create a shared approach. It is still to be seen, however, whether decision-makers will be able to overcome the rigid outlook inherited from the past: the outcomes of the UNFCCC Conference held in Durban in December 2011 and the most recent meetings do not show any trace of steps forward in this direction. If an international collective action is required, however, the institutional legal setting and negotiation forums are still inadequate. This brings forward a third problem: the choice of the proper negotiation forums. A future-oriented, creative approach should mark the post-Kyoto negotiations.

Negotiation forums

The Kyoto Protocol provides a clear example of the hurdles met in both the definition and the implementation of a global agreement. The negotiation that the involved parties experienced highlights some of the causes that led to the partial failure of the Protocol, but also to emphasise the positive externalities that emerged in the course of its implementation. This helps to identify some elements of a still-to-be-defined theory of governance of global processes to deal with global public goods.

1. The first requirement is the scope of the agreement. Since emissions have the same effects on the atmosphere, regardless from their provenance the agreement must have a global scope and foresee commitment in a reasonably short term.
2. The second requirement is the comprehensiveness of the agreement. It is imperative to prevent regulatory arbitrage and carbon leakage (namely to prevent companies from simply moving plants—and emissions—to countries that have looser rules in response to imposing stricter ones) that may thwart efforts and encourage free-riding. The overarching issue in circumstances characterised by the use of collective resources is, in fact, as observed by Eleanor Ostrom³⁷ to “prevent negative outcomes that can result from the unilateral action of individual actors”.
3. The third feature is thus the need (and the possibility) to conduct negotiations at a higher level, namely within international institutions that embrace both the most historically responsible countries for the current atmospheric pollution (America, Europe, Japan, industrialised economies), and those countries expected to produce an ever growing share of emissions due to their recent, fast-paced growth (particularly China, India, and Brazil, but also Indonesia, Mexico and South Africa). This challenge is heightened by the perception of a severe and general unbalance in the world governance of economic processes, as proved by the inability to conclude agreements in several economic spheres (WTO to nuclear energy).

In this aspect, two requirements must be met: the presence of an authoritative supra-national institution and negotiations equally informed by principles of both cost-effectiveness and justice to enable a policy of voluntary co-operation. Such a participation can find different expressions: a (possibly enlarged) G8, in the framework of the Major Economies Meeting (established by the United States in 2007 to gather in a single negotiation forum the countries that account for 80%

³⁷ Ostrom, *Governing the Commons*, cit.

of global emissions), or under the aegis of the United Nations (within the UNFCCC). Lastly, climate change negotiation became a topic of discussion within the G20.³⁸

However, a global agreement of planetary scope needs to fulfil a second requirement: a long-term shared vision, not necessarily assessed in purely monetary terms. As Kahneman, Sen, Ostrom and others remind us, the scope of appropriation of collective resources should bring the economists' attention back to the notion that non-cash relations have great importance and that, as a result, to presume that rule-making should maximise a few observable economic variables does not seem a wide course of action. In this respect, the use of flexible and differentiated tools is crucial to finalize an international agreement.

4. A potential contradiction stems concerning how to employ and allocate financial resources. As agreements and commitments involve countries quite diverse in their level of development, growth dynamics, wealth and primary needs, not to mention institutional development and organisation it does not come as a surprise that the Copenhagen Consensus —an interdisciplinary group of experts including five Nobel laureates in economics— places global warming at second-to-last place (29th) in the scale of global goals identified to be addressed by significant global investments³⁹, after hunger, disease, malnutrition, education, HIV/AIDS.

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Taking steps forward and conclusions

Did the Kyoto Protocol truly fail? Sixteen years after its signing and nine years after it went into force, it is clear that it did not yield the desired results. Notwithstanding, a number of positive outcomes that concern the political and cultural outlook have emerged. Today we acknowledge that the preservation of the planet is a crucial issue which accompanies growth and development; that this problem must be dealt with urgently, and that it does not concern just environmentalists and Ministries of the environment. From an economic point of view, after the meeting in Bali in 2007, the need to involve all the facets of society and of the economy - including the Treasuries, Ministries of Finance and Financial Institutions, called upon to devise concerted financial

³⁸ Acronyms are explained in the Appendix.

³⁹ These are Finn Kydland (Nobel 2004) Robert Mundell (Nobel 1999), Douglas North (Nobel 1993), Thomas Shelling (Nobel 2005), Vernon Smith (Nobel 2002). The analysis was commissioned by the Director of the Copenhagen Consensus Center, Bjørn Lomborg. Cfr.: <http://www.copenhagenconsensus.com/CCC%20Home%20Page.aspx>

⁴⁰ E. Ostrom, 2006, p. 301.

instruments in support⁴¹ - became ever so apparent. We can hope for the rise of greater coherence in global economic –fiscal- and environmental policy.

A few steps forward have been made. Hope is given, for example, by the outcomes of the Pittsburgh meeting (September 2009), where for the first time a co-ordinated action by national governments lead to a roadmap to gradually phase out all subsidies to fossil fuels. According to estimates by the OECD's International Energy Agency, in 2009 this effort amounted to around 312 bn dollars.

Leveraging on the widespread acknowledgement of the importance of the environmental issue, the awareness that global warming requires joint action on several negotiation grounds - economic, commercial (WTO), financial and environmental - is steadily gaining ground.

Different kinds of incentives and agreed rules are needed to motivate the diverse actors involved—including private ones—encouraging them to offer their contribution to the provision of this global public good. To this end a number of tools have already been devised and advanced: from a carbon tax to tradable emission rights, from efficiency-enhancing and energy-saving measures to the encouragement of eco-compatible consumption, to the promotion of corporate environmental responsibility arrangements. The rigid frameworks of theoretical models are gradually being substituted in favour of a greater stress on the diversity of the actual settings where we operate. The recourse to and dissemination of proactive, flexible and strongly diversified tools is in itself a positive development.

Joint efforts of public and private actors are also gaining momentum. These allow for the participation of different stakeholders while offering flexibility and the possibility to aggregate dissimilar groups, associations and collective interests. In this regard social media provides for forms of shared governance.

More generally, the issues involve the growth and transformation of the modern production system and the lifestyle of the inhabitants of the planet. It becomes apparent that the traditional (and ineffective) policies based on foreign aid must be abandoned, to pursue win-win policies. The keystone of this approach lies undoubtedly in technology, in the investments needed to encourage innovation, to bolster energy infrastructures, as well as in the compatibility of industrial, fiscal and financial policies that must accommodate the opposed needs of financing investments and of the change in global growth (made more salient by the current economic crisis).

The awareness of these factors has undoubtedly contributed to the moderately positive outcome of the negotiations during the UNFCCC's 17th Conference of the Parties (COP), held in Durban in late 2011. The Conference can be deemed to be a first, modest step forward of the climate negotiation process after the 2007 Bali Action Plan. A second period of emission reduction commitments was agreed, starting on January 1st, 2013. This was equivalent to further extending the Kyoto Protocol—set to expire on December 31st, 2012—to the end of 2020. Although the European

⁴¹ Among other instances, the establishment in Europe of a dedicated section of the SCIMF Committee can be mentioned. See the Appendix for the meaning of the acronym.

Union is the only player thus far to have confirmed its participation to the next binding commitment phase, this decision guarantees that the current market-based mechanisms remain in force and was a necessary concession to obtain the endorsement of developing countries of the second part of the package. The creation of the Durban Platform for Enhanced Action compels the international community to define by 2015 a new set of rules for containing climate change, for the period beyond 2020. This would provide for different reduction targets for the major emission-producing countries, including the US, China, India and Brazil, or rather, for countries that up until now were not legally bound by the reduction targets of the Kyoto Protocol.

To conclude, the relative scarcity of the natural resources used to generate energy and the destruction of the environment are serious restraints of the production patterns and the lifestyle of our century. The combination of these two restraints is a significant impulse for innovation.

Global equilibrium is already changing as a consequence—among others—of a number of technological breakthroughs, such as the shale gas revolution started in the United States and the ever more widespread use of renewable sources of energy. The extraction of non-conventional fossil fuels—once the environmental challenges of the hydraulic fracturing technology are overcome—will become common all over the globe. This will perhaps be impossible in Europe, where population density and strict environmental regulations offer limited leeway to this technology, but it will be commonplace in China, India, Australia and Canada, as well as in large parts of Africa, where unconventional gas reserves abound. The application of new software advances to the energy sector will facilitate the transmission of electricity from renewable sources and distributed generation through “smart networks” and to store it in advanced and innovative batteries, thus also favouring the spread of less-polluting electrical vehicles.

These developments will also be instrumental in increasing the interdependence of global regions, which in turn will emphasise the demand for a shared governance, as well as the need to rebalance international institutions –better representing high-growth countries- and redefine multilateral governance approaches to co-ordinate the efforts towards a sustainable growth.

Vast public and private investments are required to finance targeted research to promote and support innovation, to trigger a quantum leap of the new carbon capture and sequestration technologies, or a shift to fourth generation nuclear technologies and to a greater use and productivity of renewable sources. Investments are also needed to allow technology transfers to high-growth countries, enabling them to take a different path of industrial development. Last, but not least, suitable investments will enable the implementation of mitigation policies in least developed countries, particularly vulnerable to the impacts of climate change.

Economic policy is thus called upon to provide an innovative, flexible and multi-dimensional approach to overcome the theoretical limits of the above mentioned models and the, at times myopic, demands of the industrial nations. The only constant is the global goal. This is a goal to which the different levels of government can contribute, calling for the pro-active participation of

the civil society through any and all representative arrangements it shall devise. It is only from observing a conflicting and imperfect reality that economics will be able to overcome the self-absorbed and ultimately fruitless approach that has insofar prevailed.

Finally, it appears evident that the necessarily supra-national governance of the processes of change should stem from the current different models of capitalism—chiefly the “American,” the “Chinese” and the “European”—leveraging on their complementary facets and the necessity of defining composite solutions that can contribute to global growth. What clearly emerges is that rules, institutions and governments are called upon to actively play their respective parts in an increasingly shared governance model in order to overcome the restraints imposed by energy resources and the challenges in the preservation of our ecosystem.

Appendix: Index of acronyms

- BRICSAM:** Brazil, Russia, India, China, South Africa, ASEAN countries (Indonesia, Malaysia, Philippines, Singapore, Thailand, Brunei, Vietnam, Cambodia, Laos), Mexico
- CDM (Clean Development Mechanisms):** as defined in Article 12 of the Kyoto Protocol, this is one of the flexible mechanisms that enables industrialized countries (as numbered in Annex I) and transitional economies (likewise, listed in Annex I) to implement in developing countries clean developments projects—in terms of greenhouse gas emissions—and to transfer the credits accrued from such projects to their own commitments under the Protocol. <http://unfccc.int/resource/docs/convkp/kpeng.pdf>
- CO₂:** carbon dioxide
- EPA:** U.S. Environmental Protection Agency
- ETS (Emission Trading Scheme):** a system for trading quotas of greenhouse gases emissions established by the European Union with Directive 2003/87/CE with the goal of encouraging the reduction of these emissions in an affordable and cost-effective fashion.
- IPCC (Intergovernmental Panel on Climate Change):** the intergovernmental scientific forum on climate change, composed of two United Nations bodies, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) to study and investigate climate change.
- JI (Joint implementation):** as defined in Article 6 of the Kyoto Protocol, this is a mechanism to allow a country with an emission reduction or limitation commitment under the Kyoto Protocol (Annex B Party) to earn emission reduction units (ERUs) from an emission-reduction or emission removal project in another Annex B Party. JI enables zero-sum projects, as the total emissions allowances in any two countries involved remain unchanged. <http://unfccc.int/resource/docs/convkp/kpeng.pdf>
- MEM (Major Economies Meeting):** A consultation and facilitation forum launched by the United States in 2007. The MEM aims to contribute to the positive outcome of the climate change negotiations within the broader scope of the UN process through a smaller—but sufficiently representative—gathering of the advanced, emerging and developed economies chiefly responsible of greenhouse gas emissions. The 16 participating countries are: the G8 group (Canada, France, Germany, Japan, Italy, Russia, United Kingdom, United States), Brazil, China, India, Mexico, South Africa, South Korea and Indonesia. Also involved are the Secretary General of the United Nations, the UNFCCC and a high representative of the EU.
- SCIMF (Subcommittee on IMF Related Issues):** this body is charged with studying the proper financial instruments and measures to help with the adjustment toward an environmentally sustainable economy.
- UNFCCC (United Nations Framework Convention on Climate Change):** this is an international environmental treaty negotiated at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro from June 3 to 14, 1992 and later superseded by the Kyoto Protocol. http://unfccc.int/essential_background/items/2877.php

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