THE FIGHT AGAINST CLIMATE CHANGE: SOME PROPOSALS FOR ACTION FOR ITALY IN EUROPE

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1. Introduction: The framework

Climate change and global warming are ongoing phenomena. For example, eight of the 10 warmest years since 1880 have occurred in the last decade and 2015 was the warmest year ever (NOAA 2015). The Intergovernmental Panel on Climate Change (IPCC), which was established by the UN in 1988 to collect the results of the scientific research, says without hesitation that the cause of these changes is human activity and, in particular, the emissions of greenhouse gases (IPCC, AR5, SPM 2014).

There is no doubt that the consequences of these changes are potentially catastrophic, although there are wide margins of uncertainty about the size and timing. Moreover, the consequences are unevenly distributed between countries and populations of the same country. In short, the poorest are hit the most (because they have fewer means to defend themselves). A responsible attitude towards future generations requires action to be taken quickly, resorting to the mitigation of the emissions and developing adaptation and protection measures.

At least three quarters of anthropogenic emissions of greenhouse gases (GHG) are due to carbon dioxide (CO_2) from the burning of fossil fuels. This explains why the fight against climate change has focused on policies that are aimed at reducing the use of fossil fuels. "Decarbonizing" the economy is not easy or without cost. The standard of living, in fact, is related to the consumption of energy and the development of the world economy since the beginning of industrialization until the present day has been based on fossil fuels. This is because their use was the least expensive way of providing the energy that is needed for the production of goods and services and the final consumption of households.

Therefore, decarbonizing the economy involves a deep change in the energy system by leveraging technology. Practically, this means: a) consume less (energy efficiency), b) replace fossil fuels with energy sources that do not emit CO_2 (renewable and nuclear energy), c) develop forms of CO_2 capture and sequestration

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(CCS) and d) replace a fossil fuel with one that has lower CO_2 emissions for the same energy yield (as known, CO_2 emissions decrease the passing from coal to oil to natural gas).

The transformation of the energy system takes a long time, but it can be accelerated and guided by the intervention of conscious policy. We believe that, in Italy, the awareness of the necessity and consequences of the fight against climate change should be increased. Italy's climate-energy policy should be made more effective and efficient. Furthermore, Italy should become more involved in policy making at an international level as no country can think that the problem can be solved by individual actions. The objective of the proposals below is to improve the internal and international policy of Italy (in particular, within the EU) in this field.

Economists have defined the fight against climate change as a provision of a "global public good par excellence" (Arrow, 2007; Weitzman, 2015). In fact, no country is immune from its consequences (even if they are different, as noted above) and no country can alone prevent the changes that are caused by human activities from happening. Theoretically, everyone should participate in the fight against climate change (i.e., "pay" in any way). However, unlike the provision of other "national" public goods, in this case, there is no world authority that is able to impose on all countries a conduct that is liable to get the desired result. Faced with the problem of obtaining the cooperation of other countries, three attitudes are possible:

a. Aiming for an international agreement that sets the amount of emissions of all countries (or at least the widest possible number of countries).
b. Focusing on the voluntary commitment of some countries (the largest possible number) to induce others to cooperate.
c. Aiming for a more homogeneous and tighter agreement between a limited number of countries to be progressively extended to the others.

These three solutions are not mutually excluding and can be implemented in several ways. Below are some examples from past or present experience that illustrate this.

a. An international agreement, including all countries with quantitative targets, was the solution that was implicitly advocated by the UN Framework Convention on Climate Change (UNFCCC) in 1992. An attempt to follow this route was the Kyoto Protocol (KP), which set a predefined amount of emissions with a two-stroke logic: only for industrialized counties (the so-called Annex I countries) in the first period (2008-2012) and then gradually for everyone else. Although the reduction in emissions set by the KP for the countries of the Annex I in the five years, 2008-2012, has been largely achieved (emissions decreased by 9% instead of 5%), it can be said that the approach attempted with KP has failed. The failure is not so much for the non-ratification of the Protocol by the US, but for the inability of the Conference of the Parties No. 15 (CoP15 held in Copenhagen in 2009) to fix a universal quantitative limit of emissions for the subsequent periods. After that failure, today, no one thinks it is possible to reach a general agreement

that is based on the quantitative emission limits for the impossibility to share a rule that sets individual limits.

b. The decision to reduce its own emissions regardless of what other countries would have done is the road taken by the EU. The EU in 2007 set autonomously the goal of cutting its emissions by 20% by 2020[1]. A position of this kind has been proposed by some (e.g., Jaeger and Jaeger 2010), not only for ethical reasons or love of justice (the more developed countries have polluted more in the past and have the means to reduce emissions) but also, because it could lead to the development of new solutions. Moreover, if committing to substantially reducing the emissions did not involve a significant reduction in the welfare of a country, this could push other countries to follow that road without fear of jeopardizing their own well-being.

This road is also the one that has been decided in view of COP 21 in Paris. At the end of CoP19 in Warsaw in 2013 and then the CoP20 in Lima 2014, UNFCCC Parties were invited to present before the Paris Conference their "Intended Nationally Determined Contributions" (INDC) to the reduction of global emissions. At the end of October 2015, as many as 128 proposals INDC on behalf of more than 150 countries, covering nearly 90% of global emissions, had been submitted. However, the INDC way is different from the European commitment that was made in 2007 for two reasons: a) often, INDCs do not indicate a quantitative ceiling of emissions, but only a reduction compared to a baseline or a hypothetical target of emission intensity; b) the objective pursued in many cases provides a considerable increase in the total emissions. In this respect, it may be useful to take as an example the INDC of India, which offers a 33-35% reduction in the emissions intensity of its GDP in 2030 compared to 2005 (Indian Gov. 2015). The document, however, rightly refers the situation of backwardness and low energy consumption per capita in the country and stresses the need for India to develop. Consequently, India aims to achieve GDP growth of 273% for 2030 and then, assuming that it respects the commitment to reduce emissions per unit of GDP as promised, emissions would rise by "only" 143%. Obviously, nobody can tell this country that it cannot aspire to triple its per capita annual income by 2030, since today it is less than $1,000. Nevertheless the result of GDP growth compounded with that of population, is that, according to Indian INDC, emissions are expected to increase by about 4.7 billion t CO_2-eq, i.e., more than the entire current output of the 28 EU countries (4.55 Gt CO_2). In summary, the road of free choice is easy to follow but, albeit a joint effort can give some results, hardly leads countries to make very challenging promises to reduce their emissions.

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1 "The European Council emphasises that the EU is committed to transforming Europe into a highly energy-efficient and low greenhouse-gas-emitting economy and decides that, until a global and comprehensive post-2012 agreement is concluded, and without prejudice to its position in international negotiations, the EU makes a firm independent commitment to achieve at least a 20 % reduction of greenhouse gas emissions by 2020 compared to 1990" (EC, 2007).

c. Among the examples of negotiated agreements between a limited number of partners, you can certainly cite the agreements concluded between the EU Member States to respect the commitment of the Kyoto Protocol ("burden sharing agreement") and then that of reducing emissions 20% by 2020 ("effort sharing agreement"). The pledge to reduce the overall emissions by 40% in 2030 taken in 2014 has followed and will certainly continue to follow this route.

It is more doubtful whether the "joint announcement" of President Obama and Chinese President Xi Jinping in November 2014, which received a lot of media coverage[2], can be classified into this category. On the one hand, this "announcement" is more similar to the case of voluntary commitments, as it is not clear how much the two partners have pushed each other to do more than what they would have done independently. On the other hand, however, the announcement was accompanied by a series of commitments (e.g., to joint research and the exchange of technology and experience). These are typical of relationships in which the partners really negotiate to push each other to some concessions in view of the mutual benefits.

The comparison between these two cases shows that there are profound differences between the types of agreement or commitment even among a few countries: homogeneous (in the European case) vs. inhomogeneous (in the Sino-American case, since the US has promised an absolute limit on emissions, and China, a goal without absolute value); binding and monitored (in the European case) vs. without constraints and difficult to monitor (in China-US case); with the possibility (in the EU) or without the possibility of sanctions (between China-US) in the case of non-compliance with the pledge.

Looking at the three possible types of agreement and to some experiences of their implementation, it can be said that the first is the ideal solution. However, from a political point of view, this does not seem feasible. This is because it is impossible to define an absolute limit of emissions and even more to split up such an amount among all of the stakeholders. Not to mention that, even if the limits were defined, one should be able to enforce them.

The second approach is the most viable. It is no coincidence that this road has been chosen to prepare the Paris Conference but there is no hope of achieving the results that are necessary to reduce emissions to the extent required. As mentioned, currently, almost all countries have already submitted their INDCs but it remains to calculate the corresponding expected level of emissions (a not so easy task, given the lack of homogeneity of INDCs) if all "contributions" promised were kept. However, some quick calculations on INDCs of major emitters show that the goal to begin to reduce global emissions by 2020, which was traditionally given as it was needed to prevent the average global temperature growing more than 2 °C compared to the pre-industrial period, based on the current models of climate sen-

2 The US has promised to reduce their emissions by 26-28% in 2025 compared to 2005. China has promised to begin to reduce the absolute level of its emissions no later than 2030.

sitivity, is not met. This result was largely predictable on theoretical grounds. When a participant in a cooperative game does not receive a compensation that is related to its degree of effort, he tends inexorably to provide an effort that has a low additional net cost for him. This does not mean that the road of voluntary promises is irrelevant because, at least, it starts a process of large-scale cooperation. However, promises are not enough. The hope is that Paris will make progress in defining a credible verification and monitoring system and in allocating the means (financial aid and technology transfer) that will push all countries to meet their commitments.

The third path that is an agreement between a limited but more homogeneous number of countries, with the aim of progressively enlarging this number, is not entirely satisfactory from the point of view of results. However, the agreement is easier to achieve and there is more certainty that it will be complied with. This path is intermediate between the previous two: it does not immediately seek a universal agreement but, at the same time, the agreement could be geared towards defining common and binding rules. It comes to putting in place more practicable solutions than that attempted with the Kyoto Protocol, starting with the identification of "focal points" on which to concentrate on in the negotiations.

2. Moving from focusing on quantity to focusing on price

On a physical basis, what matters in climate change are global emissions. From an economic point of view, it is better if the reduction of emission occurs where it costs less. Recognizing this, long ago, economists proposed (Crocker, 1966; Dales, 1968) the idea of introducing transferable emission permits. The Kyoto Protocol picked these two principles and determined that it was necessary to reduce the global emissions and admitted the trade of emission permits both among the countries listed in Annex 1 and with those that are not listed in the Annex I. This left two legacies: a) focusing on the absolute value of the emissions and b) the development of cap-and-trade and baseline-and-credit systems of emissions trading (in the following, we neglect the difference between the two and we will make reference only to cap-and-trade systems).

As is known, the cap-and-trade (CaT) systems have two positive features: a) they allow an exact predetermined target quantity to be reached; b) they allow the target to be reached at minimal cost by trading permits. The exchange of permits on the market determines a price, which, if it comes to emission permits of CO_2, is equivalent to a carbon tax (not determined centrally, but by the market). Even a cap-and-trade system then generates a price-cost of emissions that directs the behaviour of stakeholders. However, the fact that the price of permits is determined by the market gives the CaT system a third advantage: the price of permits does not appear as a tax and, therefore, the CaT can be more easily accepted, especially if, at least initially, the permits are distributed for free.

However, the positive characteristics of the cap-and-trade have limitations. First, if the constraint on the total emissions only applies to a limited number of

countries, it is clear that the result of limiting global emissions is not achieved. Moreover, in this case, the CaT gives rise to the phenomenon of so-called carbon-leakage: the carbon-intensive productions tend to move in the countries that do not set a cap on their emissions because businesses are not subject to the cost to reduce emissions or buy permits. Another limitation arises when, within a country, the cap-and-trade concerns only a few sectors as it is with the European Union Emissions Trading System (EU ETS). In this case, the lowest cost of emission reduction is not necessarily achieved.

However, the most problematic aspect of CaT is that the price of permits is unstable. Since the quantity demanded in the short run is rigid but uncertain (depending on external circumstances, particularly the level of GDP) and the quantity supplied is also rigid (but uncertain if permits can be bought or generated outside), the price can vary greatly. This is what happened with the EU ETS, which has seen prices collapse in both the first (2005-2007) and second (2008-2012) period of application. This is because of excess permits distributed (in the first period) and for the decrease in the demand due to the economic crisis and the increase in production from renewable sources, as well as for the use of CERs and ERUs[3] (in the second period).

Faced with the observation that it is practically impossible to find a shared criterion for fixing the amount of emissions to be allocated to each country, many economists (including some Nobel laureates) have proposed not to seek an agreement on quantity but rather, on the price of carbon emissions. In a market economy, the price (an element much more visible) guides the decisions of consumers and producers and, consequently, determines the quantities produced, although these in turn feedback on the prices.

The benefits of a common commitment based on the price (carbon tax) rather than on the quantity (cap-and-trade) are numerous:

a) Setting a price gives a stable signal to those who have to reduce emissions. This allows them to make investment decisions much more easily than when the price is highly variable (such as the price of permits in the EU ETS).
b) The revenue from a carbon tax remains within the country that introduces it, as the proceeds of an international system of cap-and-trade become transfers of capital from buyer to seller countries. This is not easily accepted, especially if the amounts turn out to be significant and not initially anticipated (as opposed to the transfers by a "Green Fund", which are negotiated and are known in advance).
c) The single price seems to be fair because it indicates the same level of marginal effort that everyone should adhere to. Therefore, it should be easier to reach an international agreement on this.

[3] CERs are Certified Emission Reductions generated from a clean development mechanism project carried out in a non-Annex I country. ERUs are Emission Reduction Units generated from a joint implementation project carried out in an Annex I country. Both types of emission permits are envisaged by the Kyoto Protocol.

d) Setting a price does not limit a priori the emissions of nobody to a default value. This factor also helps to gain the necessary consensus among participants.
e) The price is easier to verify than the quantities emitted or absorbed and can be more easily used as a focal point for an agreement and to push recalcitrant to join the agreement.

For all of the above reasons (and others that are not mentioned here), many economists and negotiators have proposed independently to aim for an agreement on the minimum price of CO_2 emissions by collecting a sufficiently large number of acceding countries. First, the method for fixing the minimum price should be agreed on. This method should make it possible for the parties to have an interest in not settling on a price that is too low. Adherence to this system would be encouraged, on the one hand, by the creation of a fund to help member countries emitting below the per capita average (funded by those who emit above the average) and, on the other hand, by the introduction of penalties for non-members. These penalties could be in the form of duties, determined on the basis of the minimum price set for CO_2 (Cramton, Oknenfels and Stoft 2015).

The proposal to switch from a commitment based on quantity to one that is based on price can be formulated in a more or less rigid way. Theoretically, the ideal would be a uniform world price of CO_2 emission which would be charged on all fossil fuels so as to increase their cost of use depending on their specific emissions (Gollier and Tirole, 2015). With regard to the other greenhouse gases, the value would be fixed comparing their Global Warming Potential (GWP). However, such a proposal would have little chance of being accepted by many countries and would still pose many problems of application. Everybody recognizes that it is necessary to find a proposal that is effective, but also flexible to facilitate its acceptance. Among the measures to make it more flexible and, thus, more acceptable price-based solution, it is appropriate to recall at least two.

Firstly, it is clear that the setting of a price does not guarantee what level of emissions will be reached as the abatement cost curve and the evolution trend of emissions (mainly linked to economic growth) are uncertain. Therefore, it is necessary to balance different needs (effectiveness with a compromise between stability and flexibility). For this reason, it is necessary that the carbon price is fixed for a certain period (3-5 years?), but revised at its end. This allows the consideration of the results reached and the progress gained in the knowledge of tolerable limits of emissions. A limited period of application would also help to better tune the system.

The second measure to make this solution acceptable is to provide countries with flexibility in the introduction of a carbon price and in the use of the resulting revenue. One of the actual proposals is not to fix a uniform price but an average minimum price in order to allow individual countries to go beyond this level and not to be forced to apply it evenly to all products or sectors. However, the most sensitive issue remains to avoid a confrontation with the cap-and-trade system that has been in place for some time in some countries (especially in Europe) and apparently ready to be adopted by other big emitters (particularly China). As mentioned, the CaT system generates a carbon price, although determined by the mar-

ket either primary (auctions) or secondary (exchanges or OTC). To include the cap-and-trade in the average carbon price scheme, it is enough to calculate the proceeds of sale (if any permit is auctioned) or the market value of permits in the total revenues from carbon emissions. Another problem concerns excise duties, which are already charged on fossil fuels in many countries, and that are not called "carbon tax". Again, if the objective is to promote the maximum accession of countries to a "carbon price scheme", then, initially, all or a portion of the excise duty is calculated as a carbon tax. However, the share of excise duty that a country chooses not to include in the carbon tax at the start should no longer be included in carbon tax revenues later (we shall use this principle in the proposals that follow).

3. Some proposals for Italy in Europe

Relying on arguments that demonstrate that it is not only necessary but also, more practical and rational to start with the introduction of a carbon price to drive the transformation of the energy system in the coming decades, we formulate a policy proposal to implement this solution in Italy, with the goal that it becomes the rule in Europe. The proposal can be summarized in five points:

A. In Italy, introduce a "carbon tax", which we will call "climate contribution", and define its trend (though revisable upward) for at least a decade, aiming at an extension of the introduction of the "climate contribution" in other European countries to bring about a convergence on the minimum value of this contribution in every Member State.
B. Strive for Europe to adopt as soon as possible a floor (and a cap) price for the ETS and promote convergence between the value of the climate contribution at a national level and the floor price of the ETS.
C. Make sure that the floor is guided by the principle of greater efficiency, that is, by the removal of coal (without CCS) from the power generation within a reasonable predetermined time frame.
D. From the outset, declare and apply the "substitution principle": the climate contribution you should not add, but to replace other taxes for an equivalent revenue.
E. Pay attention to the principle of fairness by providing forms of aid (or of targeted tax relief) to poor families because the climate contribution tends to weigh to a greater extent on them.

The analytical definition of these measures may provide for different variants and requires accurate quantitative studies, some easier than others. In the following, we will only point out some aspects for each point that we consider to be important and for which the necessary information is available.

In Italy, introduce a "climate contribution" with a defined minimum path for 2030, aiming at a convergence at a European level.

Today (2015), six EU countries (Denmark, Finland, France, Ireland, Sweden and the United Kingdom) already have a carbon tax (the Scandinavian countries

since the early 90s), but with different rules and different levels (ranging from €14,5 / tonne CO_2 in France to about €100 / t CO_2 in Sweden). Even Italy had a carbon tax introduced in 1999 by the law n. 448 of 23 December 1998, which modified the excise duties on mineral oils according to their emissions and introduced a very modest tax on the use of coal, coke and orimulsion (about €0,5 per ton). However, it must be recognized that such an effort was highly fragmented in the first place because the increase in excise duties was not linked to the actual CO_2 emissions of each fuel. In addition, the new rates had to reached by 2005, with increases decided annually. In reality, this attempt was removed in 2005 for excise duties on mineral oils and for solid fuels in 2007 after the introduction of the ETS in Europe. The new "climate contribution" should avoid these errors or dangers.

First, the "climate contribution" should apply to all fossil fuels to an extent that is proportional to the actual specific emissions of CO_2 for each product, regardless of its use (principle of universality). The application of this principle aims at giving rationality to the fight against CO_2 emissions, for example, by also including transport fuels (not included in the EU ETS), which represent a very significant share of the total emissions. However, some products (e.g., gasoline, natural gas for heating) are already heavily taxed in Italy with specific duties. In these cases, our proposal is to initially turn part of the present excise duty into the "climate contribution" so as not to impact on the price of these products. However, if the value of the carbon tax were to be increased, such an increase should no longer be shielded by the presence of excise duties.

Another obstacle to be avoided is the unpredictability or lack of credibility. For the carbon tax to be effective in stimulating investment and looking for solutions to reduce emissions, the trend of its minimum value must be known in advance and be credible. Therefore, it is important to ensure that the public commitment is credible and that a period of several years in which at least the path of the minimum level of contribution is known and not downward reviewable is defined.

This point is perhaps one of the most crucial. It is fairly easy to introduce a "climate contribution" when the energy prices are low (like now). However, it is harder to keep it when the price of energy (oil and gas) rises. Moreover, it is very difficult to ask politicians to give up intervening to influence the price of energy according to circumstances, especially for the industrial sector. To confirm this, just look at the French and English example. The law on "Energy Transition", which was approved in France in August 2015, requires that the carbon tax increases from the current €14.5/t CO_2 to €56 / t in 2020 and €100 / t in 2030, but its growth will be decided each year by parliament. For its part, the British government has introduced a carbon price floor (CPF) for fuels that are used in power generation, which should have grown to £30/t CO_2 in 2020. However, recently the British government decided to change this to a carbon price support (CPS), which should stick to £18/t CO_2 up to 2020 with the following justification: the British price is much higher (at current exchange about €25/t CO_2) than the price of emission permits in the ETS (now €8.5/t CO_2) and this would result in a decidedly higher cost of energy for English businesses than that of foreign competitors.

It is precisely to overcome this risk that we propose that Italy enters the European Club of those who have a "climate contribution" (or carbon tax), but with the goal that this becomes the rule for all of the EU. In fact, if it is decided that all Member States should have a carbon tax with a fixed minimum value, it would be easier to overcome local resistance. Moreover, Member States could not independently decide to change this value or to grant exemptions to the sectors with greater lobbying power. The easiest and most efficient way to do so would be to take up the proposal that has already been developed by the Commission (COM (2011) 168), reforming energy taxation in Europe, dividing it into two parts: one based on CO_2 emissions and one based on energy content. Unfortunately, the current Commission withdrew this proposal shortly after it took office with the following motivation: "Council negotiations have resulted in a draft compromise text that has fully denatured the substance of the Commission proposal. Moreover, there is not even an agreement in Council on the draft compromise" (COM (2014) 910). Therefore, our proposal is that Italy not only enters the club of countries with a carbon tax but also, advocates for a coalition with the other EU countries that already have it in order to introduce it throughout the European Union.

Work so that the reform of EU ETS adopts as soon as possible a floor (and a cap) price and promote convergence between the value of the "climate contribution" and that of the floor price of ETS.

As mentioned, one of the main problems of the cap-and-trade is that, if you fix the number of permits to be allocated or auctioned, their price on the market can vary considerably over time according to the demand. This makes it difficult for the CO_2 emitters deciding what to do. To avoid this danger, the EU has now decided to revise its ETS to introduce a Market Stability Reserve (MSR), i.e., by auctioning more or less permits than expected based on the number of permits on the market. Since the objective (though unstated) of this measure is to stabilize the price of permits, it is simpler and more effective to set a minimum and maximum price (a collar) of permits to be auctioned to be revised at regular intervals (e.g., every 3-5 years). As mentioned, a price that is clearly visible gives more certainty to investors and can still guarantee the achievement of the desired result of emissions reduction in a more orderly way. In fact, in the case where the amount of permits to be auctioned had been set at a too high level, it is clear that their price would stand on the floor. However, this would be a signal that, in the next period, the number of permits to be issued could be decreased more than originally planned. If, on the contrary, the price reached the ceiling, it is clear that the reduction in emissions would be more difficult than expected and should be taken into account in the next round or with other policies (for example, by promoting R & D to lower abatement costs).

Since it is very difficult to set the amount of permits so that their price stays between the floor and the ceiling, and since it is likely that the authorities show a degree of caution in wanting to cut too quickly emissions (for the cost for the economy), it seems likely that the price – at least initially – lies near the floor. The floor price would become the de facto reference price of carbon emissions. The proposed solution is recommended by many economists and has already been implemented in Cali-

fornia, where the cap-and-trade was initiated in 2012. In addition, in the case of California, the price of permits sold in various auctions held so far has always placed very close to what actually represents the "carbon price" or the "carbon tax".

Being very difficult to get the abandonment of ETS in Europe (once a system is implemented, there are too many interests that push to keep it alive), and being cost-effective having a single price for carbon emissions in all the economic activities (belonging or not to the ETS), it follows that we must aim at making the carbon tax and floor price of ETS converging to the same value. Therefore, Italy should strive for: a) be adopted at European level a floor price of ETS and a carbon tax on fossil fuels coordinated with each other in their value and dynamics; b) introducing at a national level a "climate contribution" with an initial value that is close to the current price of permits (e.g., €10 / t CO_2 could be a right starting point since today the price of permits is approx. €8.5), providing that its dynamics is hooked to the floor price or the European carbon tax to be introduced hopefully in the EU.

Work so that the floor price is driven by the principle of efficiency, i.e., the replacement of coal in electricity production within a span of time.

More than two thirds of the emissions of ETS sectors depend on the production of electricity and heat (combustion of fuels sector). Therefore, to reduce the emissions of ETS sectors, EU Member States must act especially in the electricity generation and do it as cheaply as possible. To do this, we will try to show that it is necessary to fix a base price of permits that, in a few years, no longer make it competitive to produce electricity from coal without carbon capture and storage (CCS).

In the long term, there are three roads to completely decarbonize electricity production: the use of renewable energy sources, the use of nuclear power and the capture and storage of CO_2. The weight of each of these will depend on the cost-effectiveness and technical progress, on social acceptability and on the policies that are pursued. The European Union has already produced a document of long-term vision named "Roadmap for moving to a competitive low carbon economy in 2050" (COM (2011) 112 final). This sets out the aims of reducing overall emissions by 80% and having near-zero emissions in the electricity sector in 2050. In the accompanying document, "Energy Roadmap 2050" (COM (2011) 885 final), the Commission identifies six scenarios of transformation of the electricity sector. In all scenarios, the share of renewable generation rises much (from 14.3% in 2005 to between 59.1 and 83.1% in 2050), but the growth is obviously progressive and in no scenario, the use of fossil fuels in power generation disappears[4].

The decarbonization goals for 2050 are still indicative. Instead, the milestones for intermediate dates should be fixed in a more demanding and precise way. The EU Council of 23 October 2014 ruled that the EU is to reduce its emissions by 40% by 2030 compared to 1990, and that ETS sectors must contribute with a reduction of their emissions by 43% compared to 2005 (EC, SN 79/14). To achieve this goal, bearing in mind that more than half of the road has already been trav-

[4] The cancellation of emissions from fossil fuel plants is entrusted to CCS.

elled, the ETS sectors must reduce their emissions of 640 million tonnes CO_2 eq in 2030 compared to 2014. In addition, the European Council agreed that the share of renewable sources must reach at least 27% in 2030. Furthermore, in a preparatory document of that decision, the Commission also indicated that this target is consistent with a market share of at least 45% covered by renewable energy the electricity sector (COM (2014) 15 final).

Of course, renewables could be developed even more to reach the ETS target. In fact, reducing GHG emissions and increasing the use of renewable sources are certainly synergistic goals. Increased production from RES helps to achieve the objective of the ETS and increased the target of ETS – driving up the cost of producing electricity from fossil fuels encourages increased production from RES. However, the two goals are also independent and, above all, can they be pursued independently? It is hard to argue that this is true. The primary motivation of the promotion of RES, in fact, is the reduction of GHG emissions, as shown by the fact that, in all European countries, the development of RES is put first in the list of policies to reduce GHG emissions (EEA 2015). These policies entail costs.

Following this, the development of renewables should be pursued in a more coordinated way, with the goal of reducing GHG emissions. This has not yet happened in Europe, where the promotion of RES was set as an independent goal. This decision has indeed led to a strong growth of renewables, but with high costs. It has also helped to lower the price of permits (European emission Allowances, EUA), greatly reducing the incentives for investment to reduce emissions in other sectors.

As an example, in 2013, 452 TWh of electricity generated from RES was subsidized in Europe and the total subsidies amounted to 50.6 billion euro. As such, the average incentive was €112 / MWh (CEER 2014). If all of the incentives granted in 2013 to RES were justified by the reduction in CO_2 emissions, since the average emission from fossil fuels was 0.73 t CO_2 / MWh, the avoided cost of CO_2 would have been €153 / t CO_2, while the average price of EUA was €4.5 / t CO_2. To remedy this contradiction, either it is shown that renewables have other positive externalities that greatly exceed those of limiting CO_2 emissions or there is a need for greater coordination between the decisions on the ETS and those on the RES. In any case, the great development of renewables has been at least partly responsible for the low price of EUA (Gloaguen and Alberola, 2013), which has discouraged other initiatives. To coordinate interventions, it would be good to use a single instrument for the same goal (Tinbergen rule). Basic theory suggests that the best instrument is the carbon price adjusted on the quantitative reduction to be obtained. Therefore, we have proposed that ETS has a floor price and that this be equal to the carbon price that is set for the rest of the economy.

If you can provide a rational basis for deciding the floor price of the ETS sector, it follows that you can specify the value that should take the “climate contribution” for a certain period. Usually, it is argued that the carbon tax is not able to guarantee the achievement of a quantitative target, as the cost curve of emissions abatement is uncertain. This argument is not always valid. In the case of European ETS, the price of carbon to reach the target set can be calculated with good accuracy. In fact, after having allowed the production from RES to grow, as indicated by

the Commission (regardless of whether or not this is the less expensive road), the least expensive method for massively reducing emissions in the ETS sector is to replace the production of electricity from coal with electricity production from combined cycle gas plants (CCGT)[5]. The replacement of most of the thermal power generation from coal with CCGT would reduce emissions, as required to achieve the ETS goal (the rest of reduction would be done in other sectors).

To prove this statement, we conducted a simulation exercise (see Appendix). This shows that setting a floor price of permits in the order of €50 / t CO_2 would make it possible to replace much of the production of electricity from coal in Europe and contribute decisively to achieving the ETS target for 2030. As mentioned, this value is much lower than the average incentive paid to renewable sources. In any case, if in the future the cost reduction of renewables would make their use more convenient than that of CCGT plants, it would mean that RES production would increase and that of gas equipment would be lower, further reducing emissions (see below).

Therefore, it is in the interests of Europe and Italy that the floor price of the ETS is set on the basis of the objective to make it convenient to replace the power generated by coal and brown coal without CCS, with production from CCGT. Announcing in advance that the increase in floor price may reach €50 / t CO_2 in 2025 (except for upward revisions, if the information acquired during this period suggests it) will allow businesses and countries that have a significant share of electricity generated using coal to adapt. This adjustment does not require large investments in new CCGT plants because there is now a strong excess capacity of CCGT plants in Europe that are likely to also be closed due to the lack of clarity of European policy. It goes without saying that a floor price of ETS that grows and is known in advance also serves as a stimulus to RES and can replace the incentives for electricity production from renewable sources. The same can be said for CCS: a higher and credible price of emission permits is the best incentive to see if and at what cost this technology can become commercial. If, with this floor price, the RES managed to grow more than expected or if the CCS associated with coal plants could become competitive, nothing would prevent them from restricting the space that is left to the penetration of gas in power generation. If this does not occur, over time, the floor price should rise to allow the further decarbonization of electricity production.

Declare and apply right now the "substitution principle", i.e., the climate contribution you should not add, but replace other taxes leaving total revenue unchanged.

One of the central problems to succeed in introducing the "climate contribution" is getting social acceptance. One of the methods to achieve this is to gradual-

[5] Except for investments in energy efficiency (which have specific difficulties), the road to significantly reduce CO_2 emissions by replacing energy generation from coal to gas is certainly among the least expensive option. This connection highlights the recent approval (3 August 2015) of the Carbon Pollution Standards for Existing Power Plants by EPA in the United States, even if this country has huge cheap coal resources.

ly increase the charge starting from a low level (OECD 2013). However, in a few years, you cannot escape getting a sufficiently high level if you want to get the desired results of emission reduction. Our proposed aim to reach a value of €50 / t CO_2 to 2025 is consistent with the objective ETS. It is also consistent with the estimates of the social cost of carbon, that is, with some estimates of the damage expected from climate change due to the emission of one tonne of CO_2 (e.g., US government in 2013, with a discount rate of 3%). Nevertheless, according to some studies (Jenkins, 2014), the willingness of the population to pay for these policies is significantly lower.

Especially in countries like Italy and other European countries, where the level of tax burden is already very high, we can expect the population to reject the carbon tax if it were to be added to other taxes. The opposition of the general population would be added to that of the sectors that are most directly affected by this measure and make it politically very difficult to introduce this measure. Therefore, to overcome this obstacle, it is important that it is made clear in a credible way that the revenue from the "climate contribution" is not an additive but (for the most part) a substitute of other taxes. It should be ensured that the average tax burden does not only increase at the beginning but also, when the revenue from the "climate contribution" increases.

It should also be noted that the solution of introducing a "climate contribution" that is a substitute and not additive to other taxes falls within the traditional proposal of environmental taxes to get a double dividend: reducing environmental impact (i.e., correct an externality) and replace other distortionary taxes with a benefit for the economy. On the other hand, this policy is nothing new for Italy. In 1999, when the budget law introduced the "carbon tax" for the first time (later abolished in 2005), it stated that it "should not lead to increases in the overall tax burden. To this end, compensatory measures are taken and in particular the statutory charges on labour are reduced" (Art. 8 paragraph 2).

When deciding on the use of the proceeds, pay attention to the principle of fairness and to double dividend.

To gain social acceptance, it is important not only that the "climate contribution" does not cause an increase in the tax burden but also, the use of the proceeds.

According to the OECD, governments have three options to use the revenue from the carbon tax: a) reduce public debt, b) reduce other taxes (e.g., income or business taxes) or c) increase spending (OECD, 2013). There are also many other classifications (e.g., Bowen, 2015; Elbeze and de Perthuis, 2011) but, basically, they are all related to the three basic classes that set out by the OECD, what changes is the internal structure of these entries. Of course, it is also possible to allocate the revenue to more than one item at a time.

The absolute constraint to be respected in deciding the use of the revenue is not to undo the effects on emissions reduction (for example, by giving compensation to families or businesses based on their use of fossil fuels). Once consistency with the spirit of the tax is respected, governments have many choices.

Economists suggest cutting taxes for businesses and / or individuals as the main use, as this would cancel the depressive effects of the carbon tax. However, it must

be remembered that its impact is not equally distributed across the population. Families with low incomes, workers and investors in emissions-intensive industries and the population living in areas where these sectors are more developed suffer the most. At least partial compensation given to these categories seems appropriate for equity reasons and for fostering social acceptability. Especially since tax systems are normally progressive to redistribute wealth in favour of the poor, it appears highly desirable to provide compensation for the poorest.

Several solutions have been proposed to cope with this problem. The simplest one is to provide a subsidy to families below a certain income. Of course, you can imagine different solutions. However, it should be noted that, according to our suggestions, initially, the carbon tax would have no impact on families in Italy because ETS for electricity is already in force (and so the power sector would be exempted). Meanwhile, for gas and fuels, the climate contribution would replace a portion of the excise duty (which, today, is much greater than the assumed carbon tax). However, in the longer term, the problem would arise and, as mentioned, it cannot be ignored.

It should also be remembered that, in Italy, there is already a "social bonus" for families "facing economic difficulties" for both electricity and gas bills with amounts and conditions that are updated every year. There are also other forms of public support. A more comprehensive treatment of this aid is needed, as well as the introduction of a carbon tax, which could be an opportunity both to cover part of these costs and rearrange public assistance to the poor.

According to estimates made in other countries (Dinan, 2012), the cancellation of the effects of the carbon tax to 20% (or 40%) of the poorest people would not need to bind more than 12% (or 27%) of the revenue. This would leave much of the revenue available for the reduction of other tax deductions, as we suggested above.

The revenue from a carbon tax can also be used to finance other environmental initiatives such as the promotion of RES or energy efficiency. Not only is this destination strongly supported by environmentalists but also, it is included among those that you must allocate at least 50% of the revenue from the auction of ETS allowances, according to the EU Directive 2009/29/EC. In our opinion, these uses are justified when it comes to promoting R & D to be financed with public funds, but much less so when it comes to promoting the deployment of these technologies. For example, if the revenue from the carbon tax was used to assist individuals who install renewable sources, you would have a double incentive that would be distortive. This is because, on one hand, the RES are already encouraged by the carbon tax. On the other hand, they would receive a subsidy, thanks to the proceeds of the carbon tax. Therefore, we must pay close attention to the use of the revenue because there are lobbies that push to get a double benefit from a carbon tax at the expense of the general welfare.

Appendix

Calculation of results obtained with a floor price of ETS set as to switch from coal to gas in electricity generation.

We assume that the demand and production of electricity in the EU in 2030 is equal to 3800 TWh, which is consistent with the scenario of low economic growth in the Roadmap 2050 (SEC(2011) 1565 final). This choice is justified by the fact that electricity production has not grown in Europe between 2010 and 2014.

As for the composition of the sources of supply, we assume that the share of RES grows up to 45% (value indicated by the Commission as consistent with the objective of 27% of overall share of renewables) and that the place of nuclear power will decrease (especially for the closure of plants in Germany) from 27% in 2013 to 18% in 2030 and 3) the rest (37%) is produced by fossil fuels (see Table 1).

For fossil fuels, we make the assumption that CO_2 emissions per MWh produced in 2030 by each type of facility decrease by 7-8% mainly because of the closure of older plants. In addition, in order to calculate the potential impact on emissions of a floor price addressed to drastically reduce the use of coal (without CCS), we consider two scenarios. In the first scenario the breakdown of generation from fossil fuels is kept constant as it is at present (Constant fossil fuels shares scenario). In the second scenario much of the production from coal is replaced by gas driven by a rising cost of emission permits in order to reduce further CO_2 emissions (Decarbonization driven scenario).

With these assumptions, we can calculate the estimated emissions in 2030. The results reported in Table. 1 show that, with the latter solution, it would be possible to reduce emissions of 440 Mt CO_2 compared to 2013. This result would allow the electricity sector to reduce its emissions a bit more than 43% compared to 2005, which is the ETS target. However, it can be assumed that the over performance of the power sector is also needed because, so far, the reduction of emissions in other sectors ETS has proved much more difficult.

Table 1 - Electricity generation and CO_2 emissions in EU-28

	Latest available data			**Constant fossil fuels shares**			**Decarbonization driven**		
	2013			**2030**			**2030**		
	Generation		**Emissions**	**Generation**		**Emissions**	**Generation**		**Emissions**
	TWh	**%**	**$MtCO_2$**	**TWh**	**%**	**$MtCO_2$**	**TWh**	**%**	**$MtCO_2$**
Total	3261,5	100,0%	1099	3800	100,0%	952	3800	100,0%	679
Of which:									
RES	886,0	27,1%		1710	45%		1710	45%	
Nuclear	876,8	26,8%		690	18%		690	18%	
Fossil fuels	1498,7	45,8%	1099	1400	37%	952	1400	37%	679
Coal and lignite	857,5	57%	797	801	57%	681	200	14%	170
Petroleum products	61,3	4%	47	57	4%	44	30	2%	23
Natural gas	507,4	34%	222	474	34%	197	1100	79%	457
Coke, blast furnace & others	72,5	5%	33	68	5%	30	65	5%	29

In order to calculate the value of the carbon tax, which would make it convenient to replace coal plants with gas plants to generate electricity, we must know: a) the fuel consumption per kWh generated of each type of plant; b) the CO_2 emission per kWh generated of each type of plant; c) the unit cost of coal and gas.

Eurostat provides both generation and fuel use data for different types of plant in 2013. Thus, it is possible to deduce the actual fuel consumption per unit of electricity generated (the heat rate) in 2013. We assume that there will be an improvement in energy efficiency of 7-8% (as in the analysis of emissions above). The specific CO2 emission can be derived by multiplying the heat rate by the emission factors of each fuel. Based on these data, we calculated an average emission coefficient of 0.86 tCO_2 / MWh for coal plants and 0.40 tCO_2 / MWh for gas-fired combined cycle plants.

As for the unit cost of fuel, we considered as representative of the costs in continental Europe the average costs of imported gas and coal for power plants in Germany published by German Federal Office of Economic Affairs and export control (BAFA).

Based on these data, we calculated how much it should have cost the emission permits to make equal the cost of production due to fuels in the two types of plant. The results of these calculations are reported in Table 2. As can be seen, the value of permits to make indifferent variable costs of fuel in the last 10 years has been comprised between €25 and €65 per ton of CO_2. The "indifference price" of permits tends to rise when the ratio of the price of gas to coal increases and, at equal ratio, when the gas price goes up. Therefore, it is not possible to determine a priori the value of the floor price of EUA that gives absolute certainty that the replacement of coal with gas is cheaper. However, whereas the average for the period was €44 / t CO_2 and coal-fired generation also involves other variable costs higher than those of gas, which were not taken into consideration, one can say that setting a value of the floor price permits at €50 gives reasonable assurance of making coal-fired generation not competitive with that of gas.

Consequently we think it is appropriate to aim for arriving at a floor price of emission permits (or of a carbon tax) of €50 within no more than ten years.

Table 2 - Fuel prices for power plants and EUA breakeven value (annual average)

	Coal price	**Gas price**	**EUA breakeven price**
	€/GJ	**€/GJ**	**€/tCO_2**
2005	2,219	4,479	25
2006	2,108	5,926	50
2007	2,329	5,55	40
2008	3,839	7,45	39
2009	2,69	5,794	36
2010	2,912	5,726	31
2011	3,651	7,133	38
2012	3,175	8,061	62
2013	2,7	7,656	65
2014	2,489	6,538	52
2015 (1st sem.)	2,423	5,989	45
Average 2005-15	2,776	6,391	44

Source: our calculations based on BAFA's data

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