Italy facing the EU Emissions Trading Scheme: some scenarios by the ICE model (POSTER)

by
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This paper focuses on Italy in the context of the Kyoto Protocol. According to the Annex I to the last National Allocation Plan (NAP), Italy's emissions are 95 Mt. CO_2 eq. above the Kyoto target of -6.5%, i.e. 19% over the goal. This paper proposes a critical analysis of the Government plan and NAP (National Allocation Plan) based on the analysis of recent Italian energy history and a wide set of policy measures that have been stated in formal documents and not implemented. The study is performed using the ICE (Italy's Carbon Emissions) model. ICE generates energy and carbon emission paths up to 2020 and elaborates sensitivity analysis on caps, carbon prices, and other variables. In particular, the research focuses on the Italian power sector under alternative scenarios of emissions and caps.
A conclusion of our analysis is that a significant purchase of carbon credits on the international ET market is necessary. Given the troubled Italian public finance situation, buying carbon credits could represent an unplanned, and maybe not feasible, heavy burden.

The EU ETS and the two NAPs

The EU ETS was launched on January 1, 2005 as a milestone of European climate policy towards the Kyoto commitment and beyond. Member States have a certain degree of freedom in setting their caps (they submit a National Allocation Plan to the Commission), even though the European Union recommends coherence between the countries' Kyoto target and the caps. Thus, the EU ETS can be seen both as an opportunity to implement strict energy policies required at higher level (the EU) and as a proof of the countries' real willingness to reduce their emissions.

In preliminary Phase I (2005-2007), the EU ETS regulated CO_2 emissions from installations over 20 MW, which means about 40% of EU emissions. Those emissions were capped at 6600 $MtCO_2$ over the three years. Almost a quarter of all Phase I allowances were allocated to Germany, while Italy, Poland and the UK received nearly 10% each. The power sector collected almost 55% of total allowances.

Actually, 2005 verified emissions were more than 3% below what had been allocated to countries that year and preliminary verified 2006 emissions data suggest a long market for 2006 as well.

Given the experience of Phase I, it was expected that the caps in Phase II (2008-2012) would be tighter. So far, the submitted NAPs set the average annual cap at 5.8% below 2005 verified emissions (EEA 2007). Moreover, the penalty for non-compliance will rise from 40 to 100 Euros.

The first Italian NAP

Given the above mentioned data on Italy, a reasonable expectation was that the EU ETS could be used as a tool for enforcing strong emissions cutting policies. During Phase I, such an expectation was disavowed by reality. As showed in the next figures, for a number of reasons, the Italian caps were high and did not bring the country much closer to its target

The first draft of the Italian National Allocation Plan for Phase I (NAP1) was presented at the end of April 2004. Then, in July, a revised NAP1 was issued. Only in February 2005, after extensive consultations, a "final" version was submitted to the European Commission, who required a further revision. Finally, the ultimate NAP1 was published in November 2005. As a consequence of this irresolute behaviour, Italy was basically excluded from the first year of the European Carbon Market.

NAP1 substantially revised the CIPE Resolution 2002, giving new reference figures about emissions' inventory and forecast. The cap for each activity is calculated on the basis of sectorial growth rate evaluation. We focus on the power sector since it is the major actor in EU ETS. The following table reports the total amount of allocated allowances and the thermoelectric sector specific cap.

Tab 3: Allocated allowances Phase I (NAP 2005)

	2005	**2006**	**2007**	**annual average**	**verified emissions (average 2005-2006)**
Total allocated allowances (MtCO2)	221.79	224.87	219.81	**223.6**	**226.5**
Thermoelectric (MtCO2)	131.08	133.81	128.41	**131.1**	**144.1**

If we compare these values with the 1990 level of CO_2 emissions for EU ETS sectors (210.2 $MtCO_2$ according to the same document), the Italian NAP1 allows an emissions level which is on average 6% higher than the 1990 one. It does not seem to be very "consistent" with a total 6.5% reduction required by the EU Burden Sharing Agreement. 59% of the allocated allowances are collected by the thermoelectric sector. Those caps resulted from a large process of negotiation and lobbying. Actually, even if they were judged quite generous, verified emissions (2005-2006 average) exceed them (EEA 2007).

The second Italian NAP

The first draft of the second Italian National Allocation Plan for Phase II (NAP2) was submitted to the Commission in December 2006. Then, after the Commission's decision issued in May 2007, a new "Decision Scheme" was published in January 2008. At this moment, the last version of NAP2 is dated February 29, 2008 and entails the reductions required by the European Commission (-13.25 $MtCO_2$ per year). The caps are listed below:

Tab. 4: Allocated allowances Phase II (NAP 2008)

	2008	**2009**	**2010**	**2011**	**2012**	**annual average**
Total allocated allowances ($MtCO_2$)*	200.68	192.43	185.37	173.68	171.34	**184.7**
Thermoelectric ($MtCO_2$)	101.27	93.03	85.96	74.27	71.93	**85.29**

*Except the reserve for new entrants (16.93 per year)

The annual average allocated allowances have been strongly reduced if compared with NAP1 (-17,4%), together with the relative weight of the thermoelectric sector (in NAP 2 it collects on average the 46% of the total amount).

Even though Phase I caps were not very strict, Italian emissions have gone beyond. In Phase II caps are really stringent but, considering the previous experience, we believe this won't decrease CO_2 emissions. That is why the evolution of carbon market and the price of allowances are definitely relevant for Italy.

To conclude, we would just underline how difficult is to cope with these documents, since each version contains different figures. The following table compares some key points included in each document:

Tab 5: Comparing data from Italian Government official documents

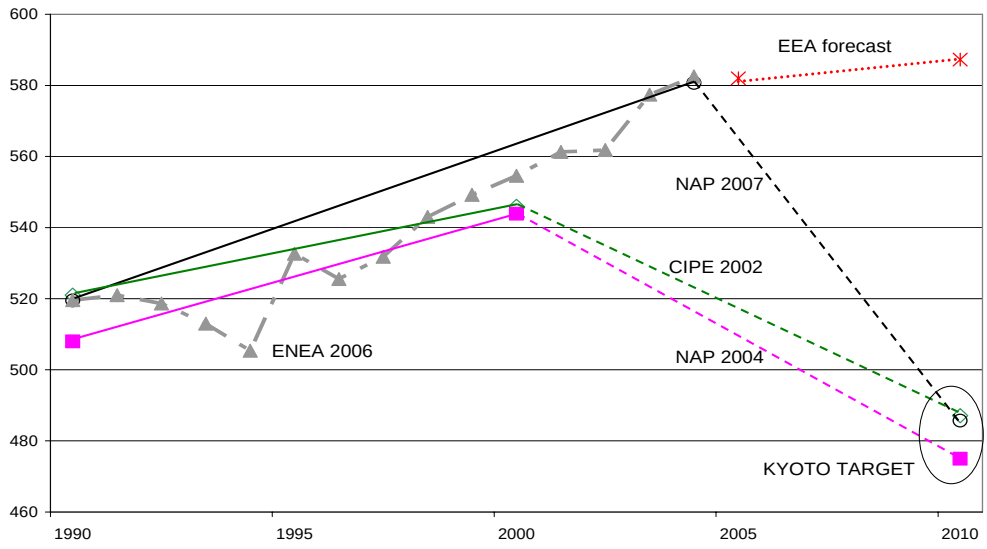
	Cipe 2002	Nap1	Nap2 (draft)	Nap2
GHGs Emissions in 1990 ($MtCO_2eq$)	521.0	508.0	519.79	519.5
Kyoto Target ($MtCO_2eq$)	487.1	475.0	486.01	485.7
GHGs Emissions in 2000 ($MtCO_2eq$)	546.0	543.9	583.33[a]	580.7[a]
BAU Scenario to 2010 ($MtCO_2eq$)	579.7	613.3	n.a.	n.a.
Distance from Kyoto target ($MtCO_2eq$)	92.6[b]	138.3[b]	97.32[a]	95[a]
Scenario with P&M to 2010 (with CDM) ($MtCO_2eq$)	528.1	563.7	n.a.	n.a.
Energy Industry Reference Scenario ($MtCO_2eq$)	144.4	175.3	n.a.	n.a.
Industry Reference Scenario ($MtCO_2eq$)	80.2	83.6	n.a.	n.a.
Transportation Reference Scenario ($MtCO_2eq$)	134.7	136.8	n.a.	n.a.
Residences Reference Scenario ($MtCO_2eq$)	68.0	68.0	n.a.	n.a.
Total allocated allowances ($_{MtCO2}$/year)	n.a.	223.6	186.02 194.02[c]	184.7 201.63[c]
Thermoelectric sector cap ($MtCO_2$/year)	124.1	131.1	100.66	85.29

[a] referred to 2004
[b] referred to 2000
[c] including reserve for new entrants

As one can see from the table, figures changes more or less in each document. In relation to the forecast, a certain degree of fluctuation could be normal but the continuous adjustment of past emissions (and, consequently, of the target) is hardly credible. Furthermore, most of the declared policies have not been implemented yet. According to the CIPE 2002, between 2003 and 2010 Italy should abate, at least, 51 $MtCO_2$ through already specified actions, but, as one can see from Fig. 1, the real situation is completely different. Finally, ETS caps are quite fluctuant and for involved sectors this could be harmful.

The picture below compares these figures to official statistics from ENEA and EEA (ENEA 2006, EEA 2007). Figures seem to be quite unclear but one thing is sure: Italy is absolutely not on the track to reach any emissions reduction. In 2004 emissions were 19% over the target and the EEA scenario forecasts an emissions surplus of about 20% in 2010.

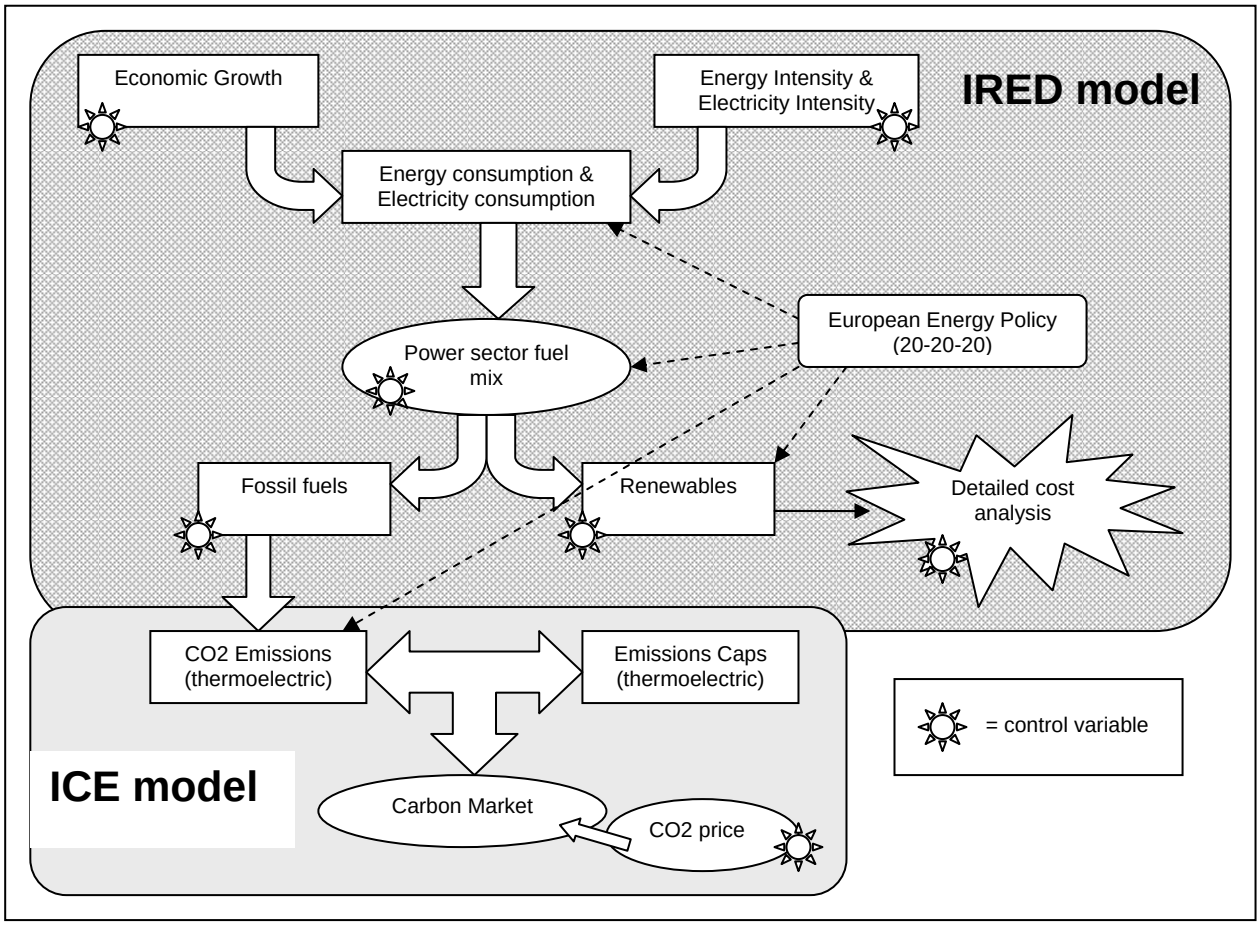
Fig. 1: Italian GHGs emissions according to different documents and official statistics ($MtCO_2eq$)



The ICE model

ICE (Italy's Carbon Emissions) is a System Dynamic model built to study the EU ETS scenario concerning the Italian power sector. Actually ICE is part of a more complex model named IRED: IRED simulates different scenarios about economic growth, energy demand and fuel mix for Italy in 2005-2030. Starting from these scenarios, ICE derives figures on CO_2 emissions and trading for the electricity sector. The following picture shows the basic structure of the two models.

Fig 2: IRED and ICE basic structure



(For a detailed description of IRED refer to Ballardin-Di Giulio-Migliavacca 2008)

As one can see from the picture, IRED's key drivers are economic growth, primary energy intensity, and electricity intensity. Economic development is set to take exogenous paths at 1%, 1.5%, and 2%, in line with Italy's macroeconomic performances over the last 10 years. Italian primary energy intensity time series has shown a upside-down-U-shaped curve peaking in the mid-Seventies. This indicator has then asymptotically reached its steady state, hovering 0.09 Mtep per 2000 USD at Purchasing Power Parity (IEA data). 0.09 is, hence, projected to be to future Italian primary energy intensity. Electricity intensity is interpolated econometrically, provided its satisfactory linear fit. The model thus adopts three electricity intensity scenarios. The more energy-intensive one projects the linear regression. The other two assume more moderate expansions, having respectively 2/3 and 1/3 increase rates of the energy-intensive forecast.

Combining electricity intensity and economic growth, IRED simulates different fuel mix scenarios for power generation. Since the power sector is the major actor in the EU ETS, this is a core element to estimate carbon emissions level and then compare it to the sectorial cap. We consider different CO_2 price dynamics in order to simulate diverse carbon market scenarios. ICE could also include hypothesis about Phase III, since the time horizon runs to 2030.

Control variables are marked with a little sun symbol: the model can perform a large number of scenarios but we focus only on a small sub-group. In particular we run the business as usual scenario under different hypothesis concerning the power sector fuel mix:

- Constant fuel mix: the relative weight of each primary source is supposed to be constant (referring to 2005 National Energy Balance)
- Gas driven fuel mix: gas share is supposed to increase from 48 in 2005 to 52% in 2012
- Coal driven fuel mix: coal share is supposed to increase from 23 in 2005 to 30% in 2012

Another interesting sub group of scenarios is linked to the new European Energy Policy. As one can see from Fig. 2, it would strongly influence consumption, fossil fuel mix, renewable energy share and carbon emissions. In particular, we would remind that the last EU package on climate change sets two main targets:

- A reduction of at least 20% in greenhouse gases by 2020
- A 20% share of renewable energy in EU energy consumption by 2020

Moreover "the EU goal of saving 20% of energy consumption by 2020 through energy efficiency is a crucial part of the puzzle" (European Commission, 2008). Reaching these targets would mean to start a revolution in the European economic system, especially in the energy sector. As far as Italy is concerned, the recent history suggests that there is no room for revolutionary energy policies. In such a context, implications for the carbon market could be very huge. That is why we include a 202020 scenario in our model, even if it does not sound realistic for Italy. To build this scenario we refer to the Italian Position Paper "Energy: issues and challenges for Europe and for Italy" (2007). To comply with European targets, renewable energy should reach the 17% of total primary energy in Italy: the Position Paper evaluates the total maximum theoretical national potential for renewable energy at 2020.

Simulations

ICE base year is 2005 and simulations cover the period from 2005 to 2030. As we said before, the model entails a large number of control variables. Three energy scenarios are at study:

Scenario 1: a business as usual scenario with a sensible natural gas share increase (BAU natural gas).

Scenario 2: a business as usual scenario with a sensible solid fuels share increase (BAU coal)

Scenario 3: the Position Paper scenario: to comply with the 2020 goal, renewable energy in power sector will increase up to 17% of TPES. Renewable shares (solar, wind etc…) included in this scenario refer to the Italian Position Paper while non-renewable's share is determined residually.

For each of them, we focus on Phase II and apply three different hypothesis (A, B and C) on the CO_2 price:

Tab. 6: ICE model - different CO_2 price scenarios (Euro/tCO_2)

	Price Scenario A	Price Scenario B	Price Scenario C
2008	20	15	15
2009	20	20	20
2010	20	15	25
2011	20	10	35
2012	20	5	45

Scenario A entails a CO_2 price that remains constant on average (20 Euros). In Scenario B we suppose that for some reason there will be a large number of available allowances on the market. Consequently the price will go down at the end of Phase II. On the contrary, Scenario C assumes a short market, and therefore a strong increase in carbon price.

Scenario 1

The following tables sum up the main assumptions and results of this first scenario. The GDP growth rate is fixed at 1.5% per year. The share of renewable energy in power generation is supposed to be around 5% of total primary energy supply. The non-renewable fuel mix in 2005 is based on the National Energy Balance; from 2008 to 2012 we assume that the natural gas share will increase by 4%. From an environmental point of view this is a good option to limit CO_2 emissions but could be more expansive (compared with Scenario 2) and harmful for the security of supply. Electricity generation cost is about 0.06 Euro/kWh.

Specific fuel emissions coefficients are taken from NAP2 and refers to Best Available Technologies: to some extent they could under-estimate emissions.

During Phase II, power sector's emissions will raise from 151 to 160.3 (+6.2%) while the cap will decrease from 101.3 to 71.9 (-28%). Consequently the gap will grow very fast from 49.7 to 88.3. The model do not consider CDM and JI projects since NAP2 stated that they will be implemented in non-ETS sectors.

Tab. 7: Scenario 1 - main features

	gross electricity production	thermoelectric production	Natural Gas	Oil	Solid fuels	CO_2 emissions (a)	EU ETS caps (b)	Emissions surplus (a-b)
	TWh	TWh	%	%	%	$MtCO_2$	$MtCO_2$	$MtCO_2$
base year 2005	303.44	*253.61*	*0.48*	*0.29*	*0.23*	*144.45*	*131.08*	*13.37*
2008	309.64	269.02	0.50	0.28	0.22	150.97	101.27	49.70
2009	315.97	274.36	0.50	0.28	0.22	153.24	93.03	60.21
2010	322.42	279.81	0.51	0.28	0.22	155.54	85.96	69.58
2011	328.99	285.37	0.51	0.27	0.21	157.90	74.27	83.63
2012	335.68	291.03	0.52	0.27	0.21	160.30	71.93	88.37

The total cost of trading for the power sector is presented in the next table: Scenario C is the worst one because of the raising in CO_2 price. As far as Scenario B is concerned, we obtain a lower but still significant cost (about 3.9 billions of Euros).

Tab. 8: Scenario 1 - annual cost for Italian power sector under different price scenarios (Millions of Euros 2008, discounted at 5%)

	Price Scenario A	Price Scenario B	Price Scenario C
2008	994	746	746
2009	1147	1147	1147
2010	1262	947	1578
2011	1445	722	2528
2012	1454	364	3272
total	**6302**	**3925**	**9270**

Since ICE allows simulations beyond 2012, one could perform a speculative scenario on Phase III (2013-2017). For example, assuming that in five years the cap for power sector will decrease from 70 to 60 $MtonCO_2$, results are shown below:

Tab 9 - Phase III results assuming 20 €/tonCO_2

	Gross electricity production	thermoelectric production	CO_2 emissions (a)	EU ETS caps Phase III (b)	Emissions surplus (a-b)	Discounted annual cost of allowances for power sector*
	TWh	TWh	$MtCO_2$	$MtCO_2$	$MtCO_2$	Millions Euros 2008
2013	356.54	296.81	162.74	70	93	1460
2014	363.75	302.71	165.24	67	98.08	1464
2015	371.11	308.72	167.78	65	103.01	1464
2016	378.60	314.85	170.38	62	107.99	1462
2017	386.23	321.10	173.02	60	113.02	1457

*discounted rate 5%, base year 2008

As electricity production from fossils grows, emissions goes up and the emissions surplus continue to increase. The estimated annual average cost of ETS is about 1.46 Billion Euro 2008.

Scenario 2

Scenario 2 is based on the same macroeconomic assumption of Scenario 1. The distinctive feature is the fuel mix: during Phase II the share of solid fuels in power generation raise from 26 to 30%. As a consequence, in the same years natural gas decreases from 46 to 43%.

The end result is a sharp increase in emissions due to the higher carbon intensity of solid fuels. The difference between power sector emissions and the cap will increase from 54 to 98.8 $MtCO_2$ (+83%). On average the gap is about 10% higher then in Scenario 1 and, accordingly to that, the cost of EU ETS will increase by the same percentage.

Tab. 10: Scenario 2 - main features

	thermoelectric production	Natural Gas	Oil	Solid fuels	CO_2 emissions (a)	EU ETS caps (b)	Emissions surplus (a-b)
	TWh	%	%	%	$MtCO_2$	$MtCO_2$	$MtCO_2$
2008	269.02	0.46	0.28	0.26	155.28	101.27	54.01
2009	274.36	0.45	0.28	0.27	159.03	93.03	66.00
2010	279.81	0.44	0.28	0.28	162.86	85.96	76.90
2011	285.37	0.44	0.27	0.29	166.77	74.27	92.50
2012	291.03	0.43	0.27	0.30	170.75	71.93	98.82

Tab. 11: Scenario 2 - annual cost for Italian power sector under different price scenarios (Millions of Euros 2008, discounted at 5%)

	Price Scenario A	Price Scenario B	Price Scenario C
2008	1080	810	810
2009	1257	1257	1257
2010	1395	1046	1744
2011	1598	799	2797
2012	1626	406	3658
total	**6956**	**4319**	**10266**

Scenario 3

The third scenario complies with the 2020 European target about renewable energy. It is a highly challenging goal, but at the same time it is a big opportunity for Member State to invest in R&D and to gain ground in this sector at international level.

The model assumes that renewable energy will reach the 17% of Total Primary Energy Supply (TPES) in 2020, as required by the EU. This strong increase in renewable sources is concentrated in the power sector, with relevant investment and operative cost. As a consequence, electricity generation from non renewable sources decreases and total generation cost raises from 0.077 to 0.097 Euro/kWh during Phase II.

Referring to the following table, thermoelectric production falls from 232 to 199.6 TWh in five years (-14%) and fossil fuels mix is supposed constant.

Tab. 12: Scenario 3 - main features

	thermoelectric production	Natural Gas	Oil	Solid fuels	CO_2 emissions (a)	EU ETS caps (b)	Emissions surplus (a-b)
	TWh	%	%	%	$MtCO_2$	$MtCO_2$	$MtCO_2$
2008	232.11	0.48	0.29	0.23	133.19	101.27	31.92
2009	224.41	0.48	0.29	0.23	129.16	93.03	36.13
2010	216.43	0.48	0.29	0.23	124.98	85.96	39.02
2011	208.16	0.48	0.29	0.23	120.65	74.27	46.38
2012	199.61	0.48	0.29	0.23	116.17	71.93	44.24

CO_2 from power generations goes down by 13%, from 133.2 $MtonCO_2$ in 2008 to 116.2 $MtonCO_2$ in 2012. Nevertheless, this reduction is not enough to comply with NAP2: the emissions surplus is still positive and increases from 31.9 to 44.2 $MtCO_2$.

Tab. 13: Scenario 3 - annual cost for Italian power sector under different price scenarios (Millions of Euros 2008, discounted at 5%)

	Price Scenario A	Price Scenario B	Price Scenario C
2008	638	479	479
2009	688	688	688
2010	708	531	885
2011	801	401	1402
2012	728	182	1638
totale	**3564**	**2281**	**5092**

On the one hand, total cost of EU ETS is the lowest compared with Scenario 1 and 2. On the other hand, one should also consider the overall cost of implementation for scenario 3: expanding renewable energy from 5 to 17% of TPES in less then 12 years would entail considerable costs (about this issue, see Ballardin-Di Giulio-Migliavacca 2008). As a result overall electricity prices could sharply increase**.**

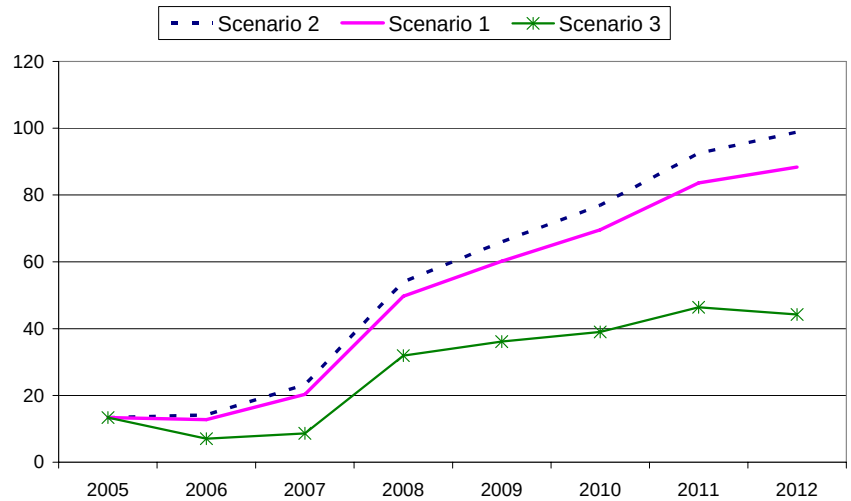
Conclusions

This paper aims to answer a big question: Italy, Kyoto and ETS, a missed chance? Even if the Kyoto Commitment period and the EU ETS Phase II are just at the beginning, we could try to guess an answer.

Our guess is based mainly on the recent Italian energy policy and on the forecasts by ICE model.

As far as the Italian Energy policy is concerned, one would say that Italy suffers from a wishful thinking syndrome, that is thinking as true something that is desirable. In fact, there is a huge distance between the policy stated in the official documents and real actions. So, the stated policies are interpreted as truly realised while they are just simple declarations on paper. This creates a self deception mechanism. The EU ETS preliminary phase has been quite a sad proof of the Italian willingness to pass from word to action. In relation to the future, the ICE model gives a valid quantitative framework to support our analysis. As already mentioned, the study focuses on the Italian power sector as a major responsible for CO_2 emissions. The graph below summarize the sectorial emissions surplus in three different scenarios. The gap is always positive and grows roughly when passing from Phase I to Phase II. It is worth noting that Scenario 3 entails a tough change in the energy sector (a sharp increase in renewable energy crowds out fossil fuels in electricity generation) but it is not enough to comply with the EU ETS caps. In other words, it seems that in Italy there is no hope of success for ETS.

Fig. 3: Power sector - gap between forecasted emissions and ETS cap (MtonCO_2)



ICE gives also a detailed picture of monetary costs of the second phase of EU ETS. The following table sums up some useful numbers.

Tab 14: EU ETS - Phase II: total cumulated cost of allowances for Italian power sector under different scenarios (Millions of Euros 2008, discounted at 5%)

		Price Scenarios		
Energy Scenarios		Scenario A	Scenario B	Scenario C
	Scenario 1	6302	3925	9270
	Scenario 2	6956	4319	10266
	Scenario 3	3564	2281	5092

We report the cumulative cost. Scenario 1 and 2 are the most feasible: the cumulate expenditure goes from 3.9 to 10.2 Billions of Euros, depending on the market price of CO_2. In Scenario C, the CO_2 price raise up to 45 Euro/tCO2 but we cannot exclude a short market and then higher prices.

If one considers also a third phase of trading (and then targets that go beyond 2012), the picture is even worse: given the current European debate, Phase III would involve new plants and sectors, with more stringent rules. Moreover, we cannot exclude that the price of carbon credits will be higher than 45 Euro/tCO_2, due to the fact that other European countries will be in the same situation like Italy.

Anyway, given the troubled Italian public finance situation, buying carbon credits could represent an unplanned, and maybe not feasible, heavy burden.

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