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Reflections, experiences and memories of a life spent in a quality and environment-oriented company [1]

Foreword

During my last eight years at ST Microelectronics I have been the Corporate Director of "Environmental Strategies and International Quality Programs".
Thinking back on those years, it seems to me that I have been very lucky: I found myself in the middle of a series of new and really stimulating situations, even if undoubtedly demanding.
ST was climbing the world ranking of chip builders; chips are those integrated circuits that represent the brain, and often the muscles, of all the electronics around us. It's enough to recall that in 1987, the year of the fusion between the Italian SGS (Società Generale Semiconduttori) and the French Thomson Semiconducteurs, the newborn company ranked fifteenth in the world. In 2001 ST Microelectronics was the third, having in the last few years recorded a yearly average profit growth of 15.4%, while on average its competitors grew "only" (if one can say that!) 11% a year. [32]
In 1993 ST, according to the precise choice of Pasquale Pistorio, its President and CEO, aimed at becoming a world leader in the environmental protection field. [6], [7], [9],[10]
Because of my job, I found myself in close contact with Pistorio. Well, anyone who met him knows how stimulating working with him is, how he is always rich with new ideas, and finally, how good he is in innovatively and profitably steering a company operating, at global level, in the most technologically advanced sector of all.

The vision

In 1993, Pistorio had identified environmental protection among ST's priorities according to three precise reasons:

- Protecting the environment is a moral duty for everyone. Therefore it is also a duty for businesses to be shared with their management.
- Having a good reputation in the environmental field is going to help the company in attracting the most valid youth coming out of universities. Today young people are definitely more aware of and sensitive to environmental issues than we were when we finished college.
- A preventive investment in environmental protection (that means before laws will impose it) brings economic benefits to the company itself. Paraphrasing Philip Crosby, famous for writing the book *"Quality is free"*, Pistorio used to say "*Ecology is free"*.

The final goal became for the company to achieve environmental neutrality. In practice that means to get to the point when productive activities don't emit any pollutants in the environment, in perfect analogy with the *"zero defects"* of quality.
As a Tuscan I remember with pride the comparison that somebody made between this business of the future with zero pollution and the Tuscan farm. For thousands of years

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In March 2002 he received in Washington the US Environmental Protection Agency **"2002 Climate Protection Award"** *<<In recognition of exceptional contributions to global environmental protection>>.*

peasants have harvested from the earth the fruits of their work and have given back to earth, without polluting, the wastes generated by their "productive process" and their own life. Actually up until the coming of the industrial era, the Tuscan farm had been the same for about three thousands years.
In my opinion, if we don't find the way to achieve this goal, that today it might seem a dream, human life will end because of what we did and do to the environment.

In practice
In 1995 ST published a small brochure, four pages that can fit in a pocket of a jacket. It is called "Environmental Decalogue": it fixes the goals that the company imposed on itself in order to reduce its environmental impacts in the next five years. Differently than the objectives identified by other associations, companies or organizations in these years, those of ST were quantified. [12], [25]
In 1999 the Environmental Decalogue has been updated for the following years. [26]
The starting point of the Decalogue is to impose over the whole ST productive system the most severe environmental laws among those of all the countries where ST plants (18 in 4 continents) are located. In this way the emission limits of the most advanced countries, with the strictest regulations in the world, have been applied even in those countries where, in that time, environmental laws didn't exist yet.
The reduction of resources consumption (energy, water, chemical products) and of pollutants emissions is planned. For the Environmental Management System it is required both EMAS (*) validation (and registration in EU) and ISO 14001 certification. [1], [2], [3]
It is also required to regularly check the environmental parameters, whose trends are reported at the Top Management "Staff Meetings", as any other important parameter.
Environmental data are validated at site level by EMAS audit and published every year in the EMAS "Environmental Statement" of each site.
I proposed to Mr. Pistorio to have EMAS done when this EU regulation was going to be approved – in 1993 -, and he enthusiastically authorized me to sponsor the audit and everything else that was necessary, but with the precise request that ST would be the first firm to get the validation in each country it was present.
I have been able to satisfy this "simple" request. [1], [27]
Part of the success of the goals given by Pistorio lays in the fact that his objectives are clear, simple, and brief. I recall: "To be considered first in the protection of the environment" forces us to achieve concrete results, make public what has been done, and do Benchmarking. [13], [18]
"To have quantified public goals, concise and understandable by everyone," as seen in the Environmental Decalogue, "forces the entire company management to work for those goals, obviously keeping the profits of investment and those activities for which everyone is responsible". [17], [19]
Finally, "to be the first in recording the name of our own production sites, in each nation where ST is present, as EMAS-validated and ISO 141001- certified" forces us to run. Do you remember the example of the lion and the gazelle that, if they don't run as soon as they wake up, would either die of hunger or be eaten?

A couple of examples
At ST, climate change, caused by those gases responsible for the greenhouse effect, has always been considered the most worrying threat to the environment. [11]
Point 3 of the famous Decalogue (2nd revision, 1999), among other things, aims: **"To reduce, by at least 10 times compared to 1990, the total quantity of the emissions linked to our energy consumption by the year 2010"**. Additionally: **"To compensate for the remaining CO2 emissions due to our energy consumption through reforestation projects or other methods, pursuing total neutrality towards the environment by the year 2010"**. Furthermore: **"To reduce PFC emissions by at least 10 times by the year 2008 compared to 1995"**. [26]
PFCs (Per Fluorinated Compounds) are gas substances not too familiar to all of us. Used in the production cycle of semiconductor devices in order to plasma attach silicon oxide and to clean the
deposition chambers, they have been in the past considered as harmless and "clean". That was until
one of their not really nice characteristics was discovered: PFC, like CO2, when freed in the

(*) EMAS: Eco Management and Audit Scheme. Council Regulation 1836/93 and 761/2001

atmosphere contributes to increase the greenhouse effect. Compared to CO2 their GWP (Global Warming Potential) is from 6500 to 23900 times more powerful and their average life in the atmosphere is up to 50000 times longer.

When transforming all the PFC emissions into "CO2 equivalents", the PFC contribution to the greenhouse effect turns out to be almost the same of that caused by the CO2 emitted by the electricity used by ST in its plants.

To give an idea of the huge quantity of electricity required by the semiconductor production cycle, in 2001 ST used 1.744 GWh – a bill equal to 1.7% of the entire turnover – almost the same as the annual consumption of an Italian town of 400,000 inhabitants, or of a North American one of 150,000! [32]

Going back to PFC, first we tried to use less of them by optimising the production processes, to utilise those less harmful for the greenhouse effect, and then to emit less of those gases in the atmosphere even through their abatement. Once it was realized that the PFC problem exists and is common to the entire sector, ST started acting together with other eco-sensitive semiconductor firms, in order to achieve the maximum result possible on the planetary scale.

In '96 ST signed, as first non-American manufacturer, the "Memorandum of Understanding" a Voluntary Agreement on PFC emissions promoted by the US EPA (the US Environmental Protection Agency) and countersigned by several chip manufacturers that have plants in the USA. [8]

In 1997, a WSC (World Semiconductors Council) working group on the Environment, Health and Safety, was created with the participation of the five main world associations of chip manufacturers. [19] At the European level the direction of this project was given to ST.

In 1999, in Fiuggi –Italy-, during the WSC Annual Meeting chaired by Pasquale Pistorio, the whole semiconductor industry officially made its commitment towards an emission reduction of 10%, as compared to 1995, by the year 2010, despite the estimated average production increase of 15% a year. Ten percent is the most severe goal of all the objectives provided by the Tokyo Protocol (8% for European Union is the strictest). [22], [24]

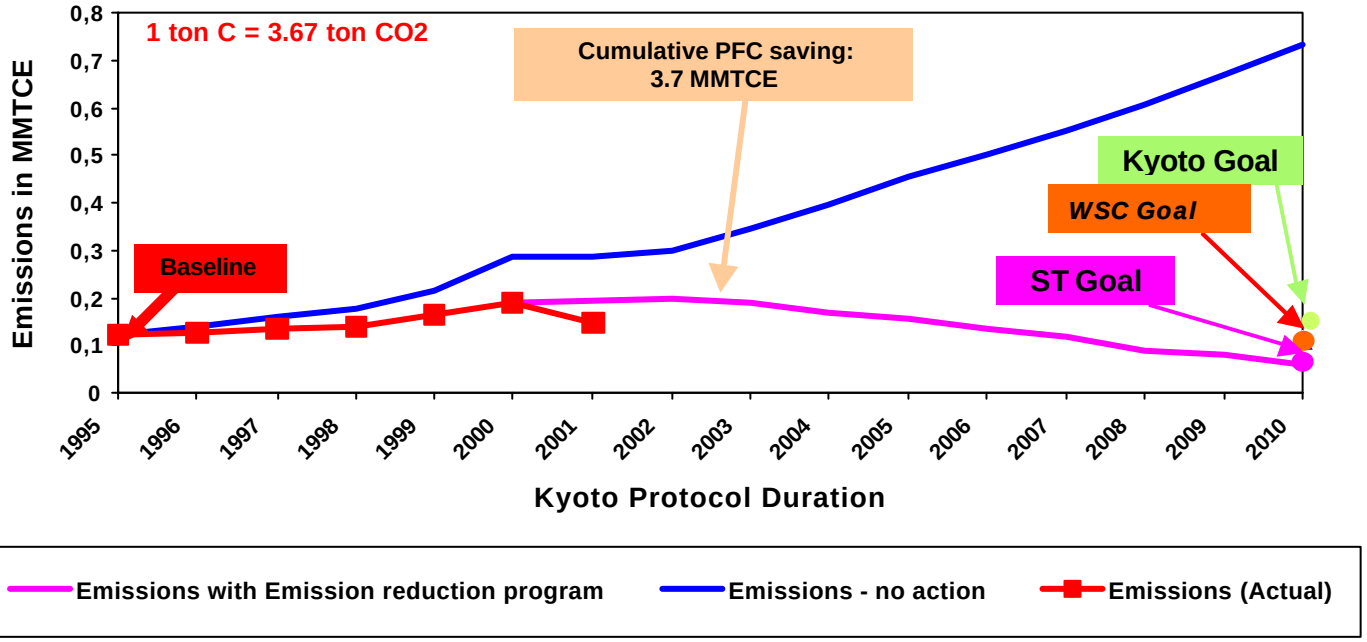

Fig.1 - PFC ABSOLUTE EMISSIONS (Calculated with IPCC Tier 2c method).

As coordinator of the European group, I was the one presenting these goals to all the WSC members. On this occasion Mr. Pistorio proclaimed that "there are moments for competing and moments for cooperating" that well synthesized the fact that semiconductor manufacturers had understood that the environment is a common issue and it was necessary to work together in order to achieve excellent results, that stimulate other industrial sectors to follow-up such an example. [24]

In 1999 ST decided to do more and better, imposing on itself more rigid objectives than those of WSC: to reduce, compared to 1995, PFC emissions by 10% as of 2008 instead of 2010. In

other terms, to reduce by 10 times the emissions per silicon wafer produced, as always compared to 1995. [11]
Fig.1 presents the trend and the objectives of PFC emissions at ST. Millions of Metric Tons of Carbon Equivalent (MMTCE) is the unit of measurement adopted at the international level. It is important to observe that in 2001 ST has already reduced the kilogram of carbon equivalent, emitted for each produced wafer, by about 50% compared to 1995. [32]

Addressing the reduction of CO2 linked to energy consumption some ST programs have recently been promoted under the name of "Energy Roadmap."[5]

- To reduce consumptions and improve efficiency, everywhere energy is consumed, by investments for the use of the best existing technologies. These investments are approved provided that they have a payback of two, or maximum three, years.
- To use cogeneration, allowing huge savings and reductions in CO2 emissions
- To invest so as to have in 2010 at least 5% of the electricity coming from renewable sources that do not generate CO2 or other harmful environmental impacts. But to invest in renewable sources when they are competitive (projects in progress at ST, that are now about to take off). [28], [29], [30], [31], [32]

Between 2000 and 2001, thanks to these energy-saving programs, ST saved $43 million. This figure goes directly to the "bottom line" and therefore we don't need to discuss further the importance of such economic returns. [32]

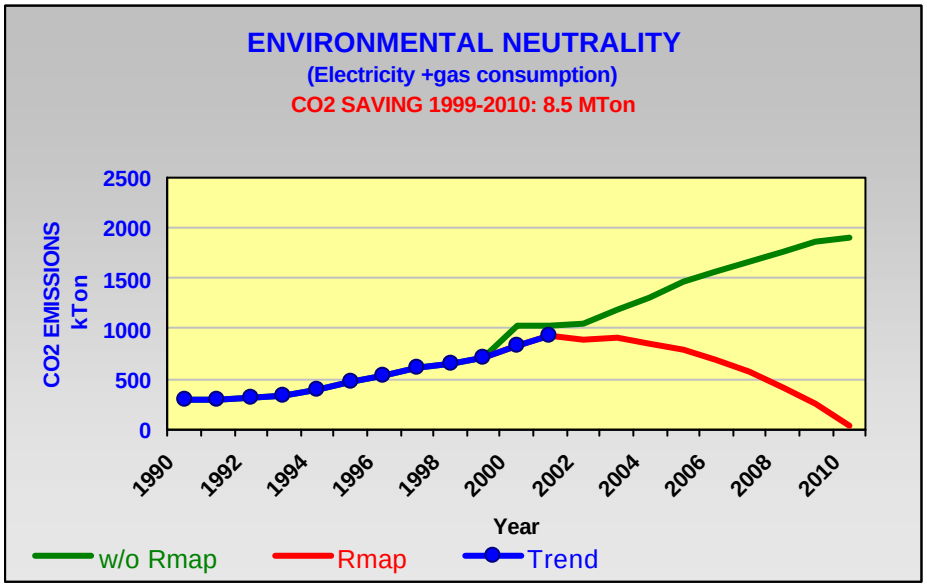

Fig. 2 – The ST program for the environmental neutrality for CO2.

Despite the consumption-reduction projects, the reduction of CO2 emissions with the use of energy coming from plants producing heat and electricity, and renewable sources, the CO2 generated by the manufacturers of electricity of the network will remain high, and it will always be utilised by ST. This CO2 will be neutralised through "carbon sinks".
For years at ST we have been working on reforestation projects. We need to understand how much CO2 can be absorbed by a newborn forest, and then in the following years up to its maturity, to understand where and how to reforest in order to absorb the excess CO2. The first forest of 530 hectares has been planted in Texas thanks to a joint project with the State University. Other smaller experimental projects have been already realised in Italy and in France. Other bigger projects, realised in areas as big as ten thousand hectares each, are undergoing final definition in the most suitable countries. In all these implementations ST will remain the owner of the "carbon credits" identified by the Kyoto Protocol. [23]
Fig.2 represents the trends in the CO2 emissions with and without the Roadmap. [32]
The ST contribution to the reduction of gas substances causing the greenhouse effect must be calculated adding the savings obtained with the PFC and CO2 emissions reduction. From the

beginning of the project to 2010 there are expected savings for more than 20 million tons of CO2.

Conclusions

Having worked in international associations, those cited above and others not mentioned, has helped the spreading of ST ideas, objectives, and programs in the environmental field, especially abroad.

This in turn caused ST representatives to be invited to conferences, presentations to the political, industrial, and academic world, and participate in working-groups on environmental issues.

This way the company's effort has been known and appreciated, but, most importantly, it stimulated many businesses to do the same and, may be, better.

Since we believe in the crucial role of environmental protection, we also are convinced that the ST approach should be considered as one of the main route for a continuing improvement in this field.

A measure, undoubtedly partial, of how much ST is now known and appreciated for its activities in the environmental field is given by the number of prizes and commendations that the Company and its men have received. The majority of these acknowledgments come from abroad: from governments, cultural, environmental, and professional associations, the media, universities, and financial organizations. [16]

Among the 37 prizes received, I would like to recall the letter that President Clinton sent in 1999 to

Mr. Pasquale Pistorio, congratulating him for all the efforts made in order to reduce the gas emissions causing the greenhouse effect.

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