

MANAGING CHANGE

best deal with new problems

Climate change is a divisive issue, some say it doesn't exist, others say it's looming with dramatic consequences; in fact, it seems to manifest itself through rising temperatures and various and frequent extreme weather events. What does it depend on? Are there historical precedents?

The inclination of the Earth's axis¹ - which oscillates between 22°30' to 24°30' with a period of 40,000 years - together with the Earth's revolution around the sun - is responsible for the seasonal trend. The atmospheric temperature, moreover, is due to the effect of gases - greenhouse gases - such as carbon dioxide (CO₂).

There is a precedent: a "warm period" - between 200 BC and 400 AD - with temperatures 1.5 - 2.0 °C above normal², and it does not seem to have caused problems, indeed; the period coincides with the maximum splendor of the Roman Empire.

The situation, however, is now very different, and man is able to influence it, in many ways: energy sources and technologies, agricultural and industrial activities, urbanization and social organization, water resources and territory, infrastructure and transportation: elements that interfere with each other, and all influence the Climate and the Environment.

Despite having already experienced, without discomfort, average high temperatures, humanity must now face a more difficult situation indeed, because of industrial activities, of the land and water exploitation, and because the world is very populated (moreover with great economic and social inequalities between the different geopolitical areas).

Ultimately, the greatest difficulties are due to: **1.** the greater weight of man (with huge quantities of CO₂ released into the atmosphere); **2.** the contribution of over 8 billion human beings; **3.** The tensions due to economic, political and social heterogeneity of the different areas³; **4.** the errors and the oversights in territorial, environmental and energy policies; **5.** the rather high speed of the manifestation of the phenomena. Hence, the need: to adopt a proactive approach (despite the lack of shared criteria by all and the low propensity to accept constraints and obligations); to avoid errors; to move quickly (in order to avoid an infinite duration of the transitino).

On the initiative of governments or private individuals, projects have been launched in the transport sector: the hydrogen train - for non-electrified routes; the airship, especially for emergencies; the wind propulsion for commercial ships, which reduces the consumption of polluting fuels. The rebirth of the AIRSHIP is noteworthy, which also involves Italy, but its diffusion will presumably require a long time.

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¹ The Earth's axis also rotates around the perpendicular to the ecliptic and describes a double cone (25,800 year rotation), in the precession of the equinoxes and can be slightly shifted during earthquakes.

² That is, those of the previous and subsequent centuries.

³ Europe and the United States, with a certain degree of well-being; the BRIC countries, with resources and capabilities; other large areas of the earth, much less developed.

Let's go over the 5 points, remembering that – even if the phenomenon is global in nature - our considerations will have to alternate national realities / themes with the global reference.

1. The role of man. In all his productive activities (agricultural or industrial), as well as, to build a house, live there, eat and wash, or for movement (of people or goods), man needs energy. He used the energy of water (first, to operate mills and machinery and, later, to produce electricity); he used, also, the wind energy, especially for navigation. Subsequently, he burned fossil fuels in plants, ending up using them excessively. For this reason, he currently releases enormous quantities of CO₂ into the atmosphere.

In Italy, no serious rationalization of the use of energy has been adopted; the only measure taken has been the limitation of the extraction of hydrocarbons in the national territory⁴; we have continued to burn fossils, making greater use of imports. The result is: rising temperatures, alternating droughts and heavy rainfall, and the occurrence of emergencies (floods, landslides and fires).

The characteristics of our territory enhance the effects; deforestation, for example, does not allow significant absorption of CO₂ for tree growth and bare territories are more easily subject to landslides.

Vast areas - the Ferrarese in Emilia Romagna, the Polesine, in Veneto - are low, compared to the sea, and therefore subject to flooding. According to a recent study (2023) by ISPRA, the vast majority of the Italian territory is subject to hydro-geological risk.

The complexity of the phenomena at play is high; in conclusion, if it is difficult to control carbon dioxide emissions, then everything must be done to try not to emit them, for example, by increasing the role of renewable sources and technologies, in particular, photovoltaic and wind power (and related conversion and storage systems).

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2. The current world population (8.2 billion) is immensely larger than in previous eras (200 million, 2000 years ago); this constitutes an extraordinary aggravation to the environmental and climatic problems we are examining.

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3. Economic, political and social heterogeneity of different geographical areas

Climate change has a different impact in different areas of the earth: some countries can afford "demanding" interventions, others cannot. For this reason, there are forms of support, paid by a certain number of states, towards those in difficulty, so that they can cope with the consequences of the new climatic conditions. Recently (Nov 24, 2024), the Cop 29 held in Baku, Azerbaijan, has decided to gradually increase the annual amount of support, from the current 100 billion up to 300 billion, in 2035. The appropriateness or otherwise of the measure can be endlessly debated: many

⁴ Pollution in the extraction phase is not dominant, it is certainly not greater than that due to infrastructure, transport, agriculture and industry.

in the self-critical West will find the sums at stake to be small, especially in relation to the number of recipients, in Africa, Asia and Latin America. On the other hand, it is also true that the countries of Western Europe and North America, already contribute, in other ways, to the support and economic development of the areas above mentioned. In fact, the fruits of the scientific and technological revolutions⁵ - urbanization, electrical and communication networks, adoption of hygiene and health measures, and development of medical science - mainly achieved in the West⁶ - have been freely transferred to the rest of the world, creating better living conditions for entire populations and accelerating the development of countries, such as India.

To document these influences, there are studies, articles and books; or even museum documentation (such as of The National Museum of Science and Technology Leonardo da Vinci in Milan).

The economic support referred to in Cop 29 and the various transfers of technological know-how and scientific, medical and health knowledge, have certainly produced appreciable results; however, not satisfactory for everyone. The governments of the countries involved, often do not take general needs into account⁷. Whatever the causes, political or economic, the phenomenon of migration has manifested itself. The countries of origin of migratory flows - in Asia, the Middle East and Africa - do not guarantee safety for everyone, either due to the disparities in economic, social and political conditions, or because of wars⁸.

Western Europe has a population of approximately 448 million; Iraq 44 million, Turkey 85 million. Africa has more than 1.4 billion inhabitants: is it any wonder that several hundred thousand people try, every year, to reach Europe? This is a real and serious problem, even if it is generally the subject of propaganda. The different economic, political and social conditions are a non-technical factor that makes the aim of governing environmental and climate phenomena even more difficult.

Some European countries and the EU have tried to regulate the flow in various ways, without much success; bellicose proclamations are useless: convincing young people and women to stay at home and place their hopes in the ground would involve the launch of development programs - credible and with adequate resources, while the current interventions are absolutely insufficient.

The Italian Government is focusing on the so-called Mattei Plan, about which, at the moment, not much is known, even if the resources that are being discussed do not seem adequate. In its historical presence on the African continent, our country has given important contributions, among which a special mention deserves the TRANSACQUA project, which we will mention later.

4. Errors and oversights in territorial, environmental and energy policies in recent years.

This is not the place to outline an energy strategy, but our considerations on the subject are functional to addressing the problem of CO2 emitted by industrial and energy plants -

⁵ With the improvements of the agricultural and industrial realities (in organizational terms or for the adoption of technologies and mechanization, automation and so on

⁶ All this as a result of about three centuries of scientific studies and research in Europe, first, and later in North America.

⁷ Paradoxically, some European countries, and Italy in particular, have performed this function by identifying some problems and also some solutions (CIAD, Agrivol).

⁸ The Russian Federation, with a population of 144 million, has been involved in more than a dozen conflicts: in Afghanistan, Chechnya, Georgia and, most recently, in Ukraine.

nuclear technology alone would be able to produce electricity without carbon dioxide emissions, but this chapter now seems closed; in any case, there are no CO2 emissions, but a lot of heat is released in the cooling waters.

Our country, without adequate rationalization of energy consumption, has resorted to massive imports of fuels and reduced internal production. The environmental reasons that we have mentioned have been given, but also economic justifications: our gas would be too expensive, but, even if the gas extracted in the Po Valley or in the Agri Valley cost a few percentage points more than the imported gas, why not use our own anyway, when the costs of extracting and distributing it consist mostly of the wages of our workers? importing energy from other countries, on the other hand, involves a pure financial outlay, without any social benefit.

Weather and climate phenomena with floods and inundations due, in part, to poor land management (deforestation, infrastructure and construction) and, in part, to extreme weather phenomena, blamed on the increase in temperatures and climate change, also presumably of anthropogenic origin (CO2 from fossil fuels for various activities and in transport).

Past errors in water and land management have had a significant impact: **i)** poor control of groundwater extraction - the precious groundwater has been used not only for food and personal hygiene purposes, but also for waste water from toilets; **ii)** the management of rivers - with the waste - of a lot of fresh surface water due to the excessive construction of embankments, not only to protect the inhabited centers, but along a large part of the route, while it would have been wiser to slow down the flow, where possible, with small barriers to facilitate its percolation underground (recharge of the aquifers) or even allowing it to flood in certain areas (salt marsh technique); **iii)** the insufficient regulation of the use of industrial and residential water (with a single water circuit, given that no thought has been given to equipping, at least in recent constructions, with a double water circuit, for the partial recycling of the water of the first, for the sanitary systems.).

5. The speed of the manifestation of phenomena leads to accelerating the transition. .

The speed of the manifestation of phenomena conditions the implementation of new strategies, in particular, that to increase the weight of renewable energy technologies.

It is necessary to immediately implement the “contrast” actions, both to reduce CO2, and to implement the new energy policy, with the construction of wind and photovoltaic production plants; which requires, however, the use of significant quantities of the energy currently available, namely that of fossil fuels! The “energy transition” is not a pure lexical expression.

Here are the terms: * dependence on fossil fuels; * the inevitable continuation of their use to allow the transition to renewable sources and technologies; * a careful diversification of imports (after a careful reassessment of the remaining endogenous resources)⁹.

⁹ Of course, it may be necessary to resort to imports for a certain share of the energy needed by the country, but it would be good to do so after having reduced any waste and also diversifying the countries from which to source. And instead, the choice was: stop production and go to consumption! Russian gas does not cost much!

There are many measures to be taken - in anti-CO₂ and energy interventions. Current energy and industrial plants must be managed in the most correct way possible, from an environmental point of view until the time comes to replace them. And the economic and social costs of the measures to be adopted must not be overlooked, under penalty of a rejection crisis, as happens with the measures for the replacement of internal combustion cars, which are responsible for the current car crisis.

At this time, with wars underway and growing poverty, the cost of energy weighs heavily, even on wage policy: if it increases, it affects production costs, making products less competitive on international markets; it then becomes necessary (especially in a transformative country like ours) to reduce other costs, such as the already low cost of wages.

Direct anti-CO₂ interventions are certainly possible. Reforestation is a natural measure of great importance and for several reasons: the massacres of trees committed in the past and the fact that almost half of the tree body is made up of carbon taken from the atmosphere (the other half being mainly made up of hydrogen and oxygen). It also allows to restore the compromised balance, to consolidate the territory, increase the extraction of CO₂ and contribute to the control of temperatures¹⁰. The effect of reforestation is not immediate, however, it is rather a long-term intervention; so let's get started right away.

In the short and medium term, however, Interventions based on the use of technologies for the capture and confinement of CO₂ are essential. Carbon dioxide can be extracted and captured with three methods: pre-combustion, post-combustion and oxy-combustion. Post-combustion appears more suitable to be applied to existing plants that will have to remain in operation during the energy transition.

Carbon Capture and Storage is the process of separating carbon dioxide (CO₂ or carbon dioxide) from the waste produced in industrial plants by the combustion of fossil fuels. The separated CO₂ is transported and stored so that it does not reach the atmosphere again. Since CO₂ production is inevitably associated with fossil fuel combustion (in a constant physical relationship per source), to eliminate it we must apply a closed-cycle methodology to thermoelectric energy production, i.e. a process that captures CO₂, transports it to a site suitable for storage and injects it into that site for storage or conservation (or sequestration).

CO₂ capture technologies currently have different stages of maturity. They can be applied to existing plants, but at higher costs than those for new plants (capture ready); all require further research and development activities, therefore, it is not currently possible to define the most promising option from the point of view of costs, management and diffusion.

One way to get rid of CO₂ is to re-inject it into depleted or near-depletion deposits; it has been the subject of experiments that are certainly not marginal, also because it allows the production of the deposit itself to be relaunched. In Algeria, this was done for about ten years, with the benefit of both relaunching production and combating subsidence; it was finally abandoned, for fear (in the long run) of instability problems.

¹⁰ In one hectare, up to 1000 trees can be initially planted, which, through successive thinning, can be reduced to less than 100 in a decade; those uprooted can be replanted in a progressive expansion of the intervention area, according to reforestation plans that we leave to true experts.

The joint application of CO₂ capture and confinement techniques and energy valorization can: **a)** prolong the operation of the plant, in environmentally acceptable conditions; **b)** compensate for the extra costs of CO₂ capture and storage thanks to the associated production of a combustible gas; **c)** valorize endogenous resources (for example, coal) used as raw material for the gas referred to in the previous point. In the retrofit module¹¹, the hydro-treatment of coal (C+H₂O — CO + H₂) is carried out with the production of hydrogen starting from the raw material coal used as a construction material; the co-produced CO, through reduction reactions, is transformed into CO₂, which will follow the fate of that produced by the plant.

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A. Transport - Innovative

Hydrogen train. In Italy, FNM, a Group integrated into sustainable mobility, has presented, together with the manufacturing company Alstom, a global leader in intelligent and sustainable mobility, the hydrogen-powered Coradia Stream train that marks the beginning of a new era in passenger rail transport in Italy; after an experimental phase, it will enter service on the Milan-Brescia line, with a view to more widespread use. This train offers a valid environmental solution for rail circulation in the non-electrified part of the network (about 30%) otherwise destined to use engines powered by fossil fuels.

Airship. In several countries¹², time and resources are dedicated to the "airship", both to combat global warming¹³ and to address uncertainties about the price of fuel: it is an aircraft that does not offer the same performance as an airplane, but consumes significantly less and can move almost anywhere. In spite of everything, the thin thread that links the first airships to contemporary ones has never broken.

The fact is that Stratospheric and Tropospheric Airships are enjoying renewed interest, the former - capable of carrying out border surveillance, defense, security and environmental monitoring functions - are complementary to satellite systems; the latter can find uses in tourism, advertising, humanitarian interventions and cargo. The Airship, in fact, is economical for overflights of spectacular areas or cities; it is already used for advertising; it is ideal for humanitarian interventions in remote or temporarily difficult to access areas¹⁴ - therefore of potential interest for Civil Protection. Finally¹⁵, even without being able to lift heavy weights, it can transport large components, without having to first section them for rail or road transport and then reconstruct them at their destination. In Italy, this is being done by institutions such as CIRA-Cnr in Capua, Universities (Polytechnic of Milan), Industries (Thales Alenia Space - Leonardo) and Associations (Dirigibile Archimede). We are aware of an initiative, not yet in the public domain, for the design of an airship with rather innovative characteristics, which sees a professor from the University of Rome as the protagonist.

¹¹ Technological integration project (under development) Conceived and named by a small technical-economic company in Rome, based on available knowledge and technologies.

¹² UK (Airlander), France (LCA 60T Flying Whales), USA (Pathfinder, Sceye, ...). Germany has the excellent Zeppelin NT but for the rest research activities, China, in addition to research activities has recently created the AS700, then there are several startups that use unmanned systems (Finland, France, South Africa, USA, ...).

¹³ It is a transport system that does not use any fossil fuels, therefore without emissions, in particular carbon dioxide.

¹⁴ could become an important means of transport (Africa, South America, Remote Areas)

¹⁵ Of course, only in the case of large airships.

Wind propulsion for commercial ships. Wind propulsion is back, even for commercial vessels. Only in sports, sailing had retained its role and charm.

The sailing ship, which required numerous and well-trained crews, has given way to ships powered by internal combustion engines; now, that it is necessary to reduce CO2 emissions, they are called back into service, also because the new wind engines can be automated and managed by a few workers. Some projects are of new conception - the Swedish "Oceanbird" - others involve the installation of rigid sails or vertical rotors, through a sort of retrofit.

Innovative wind-powered ships could reduce consumption and environmental impact by 90%; mixed propulsion systems - wind + engine - propose lower, but significant reductions in consumption and CO2 (10% -- 40%).

Some examples: they are called WindWing and are used to make the most of wind energy in large vessels. According to data from the International Windship Association (IWSA), there are already over 20 large commercial ships and a dozen cruise ships equipped with wing systems, kite sails. The model of wind-powered vessel of the moment is Pyxis Ocean, a cargo ship on which two WildWings have been mounted. These are rigid wing sails, which take the same name as the project, which can be up to 37.5 meters high and can intercept the energy of the wind, contributing significantly to the propulsion of the ship, with fuel savings ranging from 10% to 30%, depending on the type of ship and sea conditions. The sails are made of steel and fiberglass.

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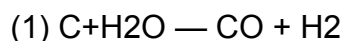
B. Retrofit Module

The module that is the subject of the proposal, on the one hand produces an additional quantity of CO2, on the other it captures and confines all the CO2 produced in the plant, and provides an energy by-product of a certain value: for this reason we define it as a retrofit of the plant to which it is applied

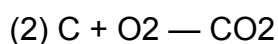
The objective of the proposed project is to research the conditions of technical and economic feasibility of this retrofit module that uses coal, as a raw material, captures and confines the total CO2 produced and pays for itself thanks to a by-product / reward - in the form of Hydrogen,

Operating scheme of the retrofit module.

The coal is transformed into a gaseous mixture, according to the schemes reported below. The starting formula is quite simple:

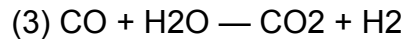


The reaction is endothermic and absorbs about 181 kCalories (considering that 1 Jaule = 0.239 calories/gr) and the necessary heat is provided by mixing a fraction of oxygen with the water vapor so that the exothermic reaction also occurs at the same time:



the reaction is exothermic with a standard formation enthalpy of -288.8 kJ, in other words energy is released during the process of composing carbon dioxide. The carbon monoxide

produced in the first stage is subsequently treated with more water vapor at 400 / 500 °C on an iron and cobalt-based catalyst:



The result consists of the precious and versatile hydrogen, H₂, and the increase in CO₂ to be captured and confined.

C. Retrofit Variants

The production of hydrogen with the complete gasification process of coal, according to the scheme outlined above, has the aim of offering a gas of great value and, presumably, much requested as a supplement (during the energy transition phase, of natural gas, as it can be mixed with it and therefore transported in existing infrastructures); hydrogen, however, has a "high energy rank" close to electricity, and could, therefore, be considered as a noble version of water gas.

Variants of more modest value and yet of potential interest during the transition are: water gas and air gas; where the former has a higher energy cost, but a higher calorific value than the latter.

Water gas is produced by passing steam over heated coal, according to the scheme: $\text{C} + \text{H}_2\text{O} \rightarrow \text{CO} + \text{H}_2$ (water gas). Since the reaction is endothermic, it is necessary to interrupt the flow of steam and reheat the coal.

Air gas is instead obtained by passing air over the coal that is always heated, according to the scheme: $2 \text{C} + \text{O}_2 + 4 \text{N}_2 \rightarrow 2 \text{CO} + 4 \text{N}_2$ (air gas), an exothermic reaction, which does not require reheating the coal as in the previous case.

In both cases, the retrofit module for existing plants - with production of water or air gas - would have a limited role compared to the one with a hydrogen prize, but not without value. Instead of the precious hydrogen prize, we would have the smaller advantage of producing combustible gases that are nevertheless capable of contributing to the production of electricity, also using domestic coal, but without the need for its direct use in the combustion chamber, but by burning the two derived gases, with economic and, albeit limited, environmental benefits.

D. Initiatives for Africa.

The Mattei Plan has already been mentioned; we can remember that our country's commitment has always had a certain consistency. Italian activity in Africa follows the three directions of political-diplomatic presence, economic investment and development cooperation. Between 2015 and 2016, our country was third for investments in the continent after China and the United Arab Emirates, demonstrating an economic interest that governments have very often favored. And the projects have and have had many merits. We would like to mention in this regard the transacqua project. Born from an intuition of the great technician Francesco Curato and carried out by the then foreign director of Bonifica (IRI Group) Marcello Vichi, the "Transacqua" study showed over thirty-five years ago that with a bold construction work it would be possible to bring water from the Congo basin to that of Lake Chad, restoring the dying "Lake in the Desert" to its original dimensions and at the same time giving Africa a

waterway, road, energy and agro-industrial development infrastructure that would have made the productive economy of much of the continent take off.

In 2017, thanks to the collaboration that began a few years ago between Dr. Vichi and the Schiller Institute, that idea, which had remained a “dream” for too long, would seem possible and would become a pilot project to demonstrate the feasibility of the Belt and Road Initiative cooperation model.

In fact, an Italian company, Bonifica, and a Chinese company, PowerChina, will carry out the feasibility study approved by the heads of state of the coastal countries (Lake Chad Basin Committee), who met in the Nigerian capital of Abuja at the end of February, and financed with an initial donation of 1.5 million from the Italian government. We do not know whether this pilot project was then implemented.

In any case, there are Italian companies, even small ones, capable of contributing to the development of projects for the African continent, starting from experiences carried out in difficult areas, such as Iraqi Kurdistan.

Surveillance via epidemiology, with collection and processing of Health Data - births, hospital admissions, diagnoses, vaccinations, deaths - can provide important indications to Health Authorities, to allocate available resources, and to promptly identify the onset of epidemics. The model, HIS, is based on the adoption of a platform for the management of encoded Health Data (DHIS2), in use in the WHO (World Health Organization). Similar projects, but referring to the processing of data relating to agriculture and water resources (AMIS) could be equally and perhaps even more interesting.

E. Emergencies.

The operational coordination for Emergencies is the responsibility of the Department of Civil Protection, which reports directly to the Presidency of the Council; its Chief, who is no longer an Engineer but a Doctor, has recently been replaced, and it is not public knowledge whether and how it is being reorganized.

In the scientific world, there is a certain interest in the computerization of the system (**EMIS**).

Among others, the previously mentioned company is active, with international experience on the HIS and AMIS systems. Progress in this regard is still rather modest, also due to the need to carry out comparisons and confirmations, from the first steps relating to the computerization of the geographic system, **GIS**, with the Authoritative level (Presidency of the Council, Presidency of the Region, Mayor). Specifically, an attempt is being made to carry out the first checks, at a regional level, to pursue the program within acceptable margins of reliability.

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In conclusion, we can make the following considerations:

a) it is necessary, but also possible, to react proactively, to limit man's contribution to climate change;

- b) initiatives must be designed and implemented - in different sectors - capable of reducing emissions to a minimum, without however threatening acceptable living conditions;**
- c) the objective mentioned in the previous point should be ensured everywhere, thanks to the prompt and free transfer of the results achieved in the most developed countries.**

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