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# CLIMATE AND ENERGY POLICY

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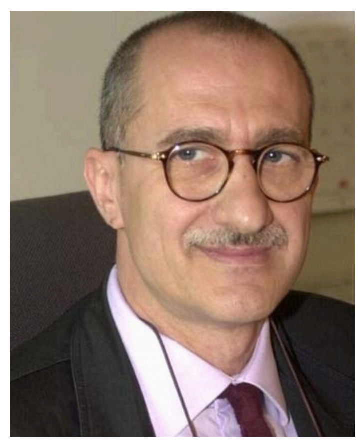

### Education & Training

- Laurea in Chemistry (summa cum laude), Università di Catania, 1979.
- Ph.D. in Chemical Physics (summa cum laude), University of Rochester, NY (USA), 1985.

### Research Experience

- Research Associate, Max Planck Institut, Goettingen (Germania), 1980-81.
- Research Associate, University of Rochester (Rochester, NY, USA), 1981-85.
- Research Associate, State University of New York at Buffalo (Buffalo, NY, USA), 1987.
- Ricercatore, Università di Roma II, 1984-87.
- Associate Professor in Theoretical Chemistry, Università della Basilicata, 1987- 1995.
- Visiting Professor, Columbia University, New York, NY (USA), 1992-93.
- Associate Professor in Chemical Physics, Università di Roma Tre, 1995-99.
- Associate Professor in Environmental Chemistry, Università di Modena, 2000-13.
- Associate Professor in Chemical Physics, Università di Modena, 2013-.

## 0. Introduction

The EU's energy policy of the last twenty years has been dead wrong, to say the least. Here it is, in a nutshell:

1) It is based on the assumption that human activities have a bad influence on climate, mainly due to CO2 emissions.
2) In order to reduce CO2 emissions several actions are needed: promote renewables, mainly sun and wind energy; promote energy saving; promote energy efficiency.
3) All the above will have the beneficial side effect of creating jobs, thereby increasing wellness and providing prosperity; in a word, this is the *green economy*.

The purpose of this paper is to show you that the three items above are – all of them – wrong. In particular, I'll show that:

1) Human activities have had no detectable impact on climate.
2) Most importantly – aside from the fact that even if they had an impact on climate (and they do not) it might even be beneficial – whatever the consequences on climate, reducing CO2 emissions will jeopardize our well being, our civilization, and even our own life. Enacting the EU policy could mean the death of millions and sentence billions of people in the developing world to lives of continued poverty and short lifespans: **Securing energy, not climate, is the real problem mankind has to face**.
3) Solar energy (specifically, wind and photovoltaic technologies) is a fraud and no CO2-emission reduction can be expected from them. Energy saving is the most dangerous maneuver we could make, and energy efficiency, as good to pursue as it might be, does not help in tackling our real problem.
4) Not by *producing* energy but by *consuming* energy jobs are created: **the *green economy* is a scam**.

## 1. Nature, not human activity, rules the climate

I am a member of the NIPCC (Non-governmental International Panel on Climate Change). NIPCC has evaluated the same scientific literature at disposal of the more famous IPCC, which, together with Al Gore, received a Nobel Price in 2007. It was a Nobel Price for Peace, not for Science. And, indeed, the members of the NIPCC, most of which are experienced and distinguished scientists, conclude that IPCC's resolutions are scientifically very questionable. This paper does not focus on climate, so I will only briefly touch on the matter.

During the last century global temperatures are believed to have been higher than about four centuries ago. How many times have you heard statements like: «Temperatures of the last 20 years have been higher than ever recorded in the last 400 hundred years». Generally, statements such as the above are true, but what do they mean, and are they alarming? The line of reasoning goes on as follows. «During the last century, industrialization, together with emissions of the greenhouse gas CO2, took place at the same time with global warming. Therefore, human activities are responsible for global warming». It is a lovely, worthwhile to be explored in depth, conjecture, which I shall call the climate/human connection conjecture or, for short, the climate conjecture. As lovely as it might be, however, the climate conjecture is not supported by scientific evidence, as I'll show.

Let me start by noticing that there is something quite remarkable about it. Throughout scientific history, the most revolutionary conjectures have been proposed. Sometimes, they appeared to be quite absurd or, at any rate, against common sense. However, what is extraordinary about science is that any conjecture, no matter how extravagant, if it has elements of truth, the more it is investigated the more its soundness emerges. Conversely, if a conjecture is wrong, the more it is investigated the more emerges as being wrong. A popular paradigm of absurdity is Einstein's relativity theory. The whole theory stands on the following absurd postulate: the speed of light in vacuum is one and the same independently of the speed of the light source. This not only sounds absurd, but is also incomprehensible. For, you know that if, inside a train riding at 100 km/h, your friend fires a bullet towards the locomotive, she measures the bullet's speed to be, say, 200 km/h, but you, who are standing at the station platform and measure the train's (and friend's) speed to be 100 km/h, you measure the bullet's speed to be 300 km/h. However, if your friend fires a photon, then you and your friend measure for the photon the same speed. Nonsense. Yet, it doesn't take long to confirm that this "nonsenses" is what reality is. And it didn't take long to verify several other "nonsense" of the theory of relativity.

Now, back to climate. Billions of dollars have been devoted to the climate conjecture stated above. And, as said, it was a quite reasonable conjecture (i.e., not as extravagant as the invariance of the speed of light). Yet, nothing has emerged to support that conjecture. Let me just mention a few points.

1. The human CO2 emissions of the last century have been exceptional in history. But has the climate of the last century also been exceptional? The answer is no. The most recent warming period – as warm as the present one – was what geologists call the *Medieval Warm Period*, proved to be so worldwide (see Fig. 1, taken from the First IPCC Report). You might question the reliability of data concerning a time so far in the past, but if you do so, i.e., if you say that data so far in the past are not reliable, then you do not have right to insist that the climate today is

warmer than in the past. Either you say that the methods that allow geologists to reconstruct the past climate are reliable, which means that you are allowed to assert that the climate today is warmer than 400 years ago *and* as warm as the climate of 1000 years ago. Or, you say that geologists might be wrong about the past, which means that you cannot compare today's climate with the climate of the past. In the first case – which is what I am inclined to agree with – you should explain what has made medieval climate as warm as today's. And this has not been explained by IPCC. There is a paper which purported to show that the Medieval Warm Period did not exist, but we now know that the paper was tainted by biased data selection and analysis.

2. As you can see from Fig. 1, the present warm period did not start 100 years or so ago, i.e., didn't start following the Industrial Revolution's CO2 emissions. And a necessary (though not sufficient) condition for action A to be the cause of action B is that B must follow A. The present warm period started about 400 years ago, well before the Industrial Revolution, at the minimum of what geologists call the Little Ice Age. The question then arises: why did the climate start getting warmer 400 years ago? Whatever the answer, it cannot be because of the Industrial Revolution.

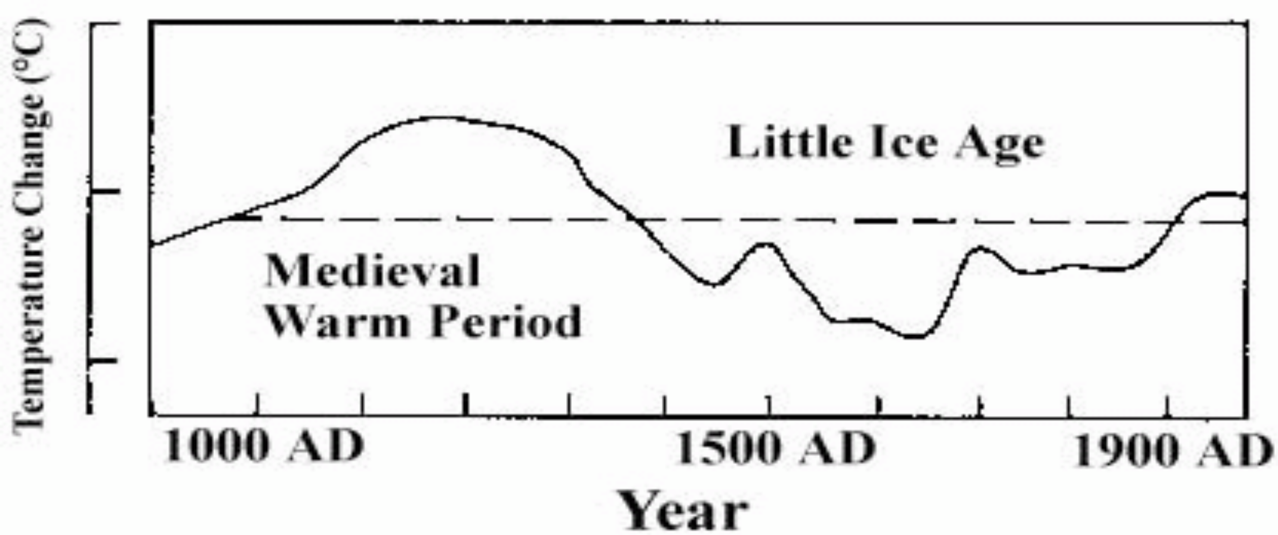


**Fig. 1 – Global temperature of the last 1000 years**

3. Of course, in striving hold on to the climate conjecture, you could still maintain that without human emissions the climate wouldn't have been so warm. However, it just happened that with human emissions the climate got actually colder. As you can see in Fig. 2, in the years 1945-1970 – during and right after the baby-boom, industrial-boom and emission-boom period – the climate did get colder. Cold to the point that during the Seventies there was, as popular as the global-warming fear is today, a fear for an oncoming glacial era (or, at any rate, for an oncoming period of global cooling). So, you do have a proof that the climate conjecture is quite wrong: things have happened that are the opposite than those expected from the conjecture. Somebody has claimed that the cooling was due to the concomitant emission of cooling-inducing sulfate molecules, and that when sulfate-reducing policies have been enforced the cooling has disappeared. This cannot be so: protocols to reduce sulfate emissions were signed in 1980 and became operative no earlier than 1990, i.e., respectively, 10 and 20 years later than

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when the climate again began to warm up. Once again, you have an effect occurring before the alleged cause. However, without entering this possibly endless debate, lets move on.

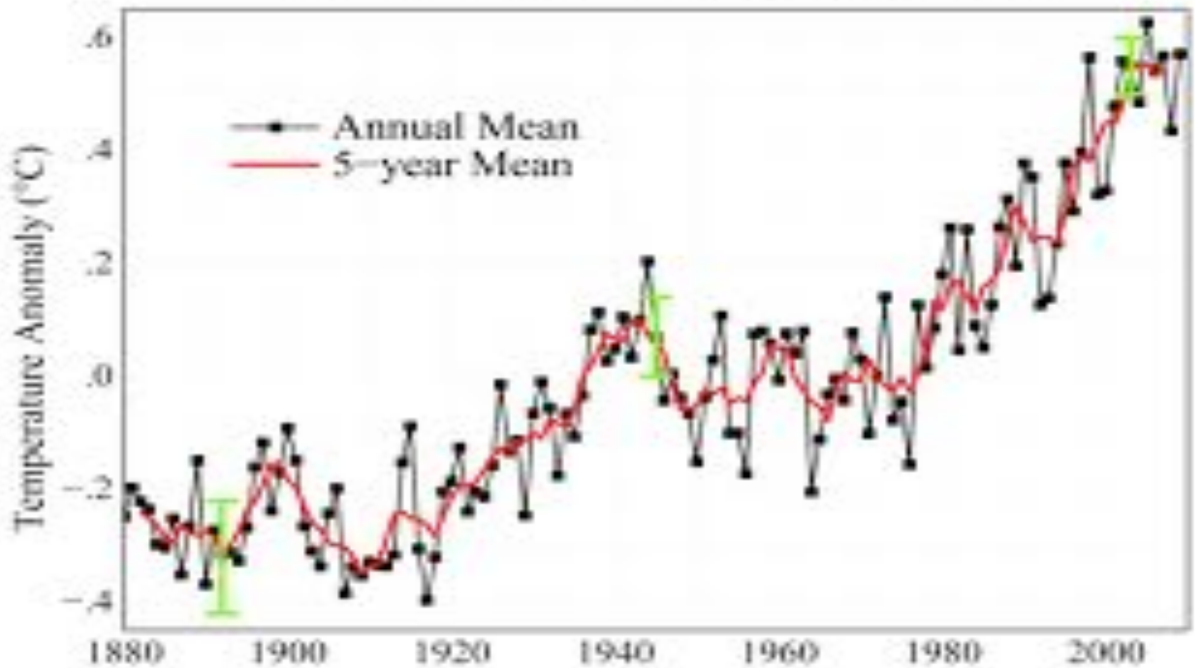


Fig. 2 - Global temperature of the last 120 years

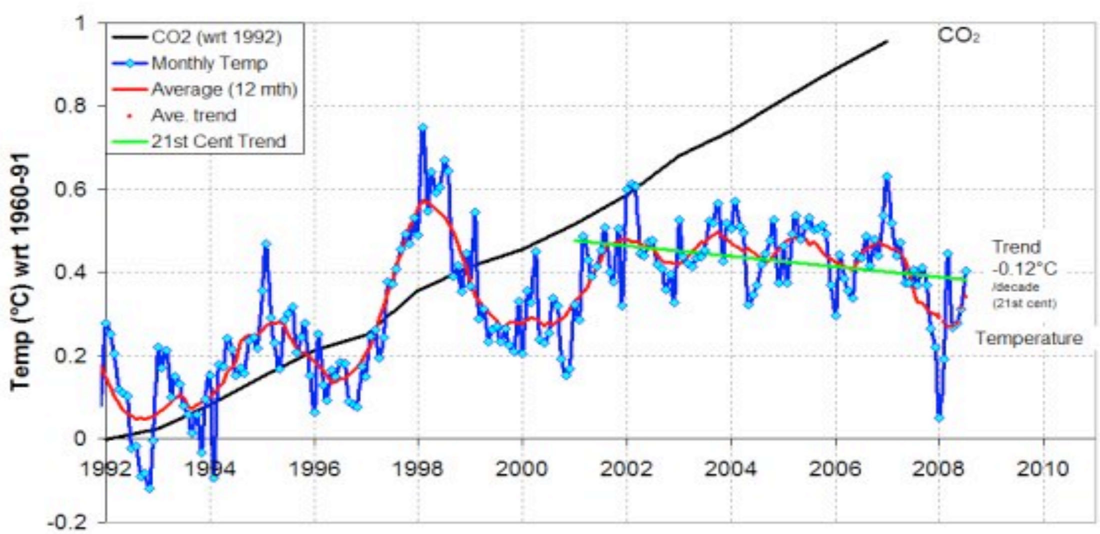


Fig. 3 – Global temperature of the last 10 years

4. There is no doubt that worldwide emissions have never been reduced since they started, not even during the last 10 years. Actually, they have kept increasing, as usual. Yet no warming has been recorded during the last 10 years or so (see Fig. 3), and this contradicts, once again, the climate conjecture.

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5. In the 90's emerged what has been called the human-induced-global-warming fingerprint: The theory based on the climate conjecture predicts that the troposphere, at about 10 km above the ground at and near the Equator, should warm up more than it does at ground level.

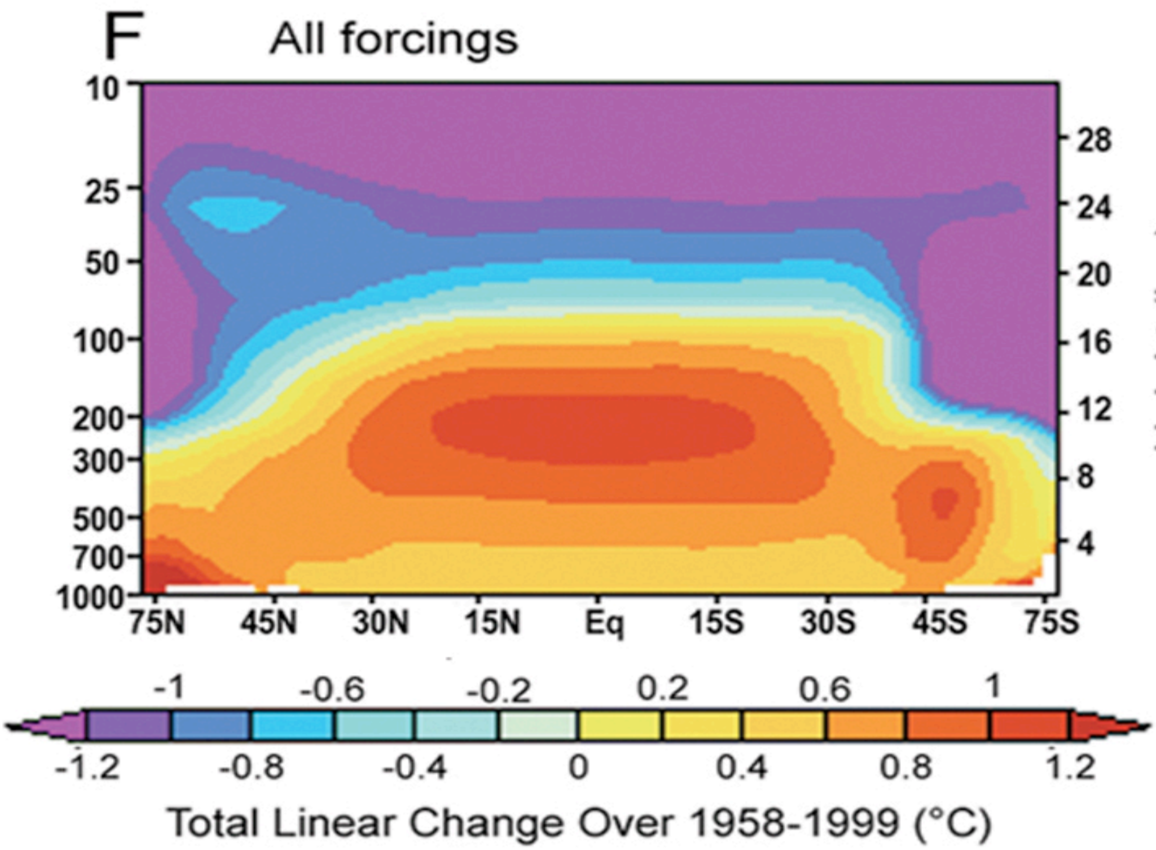


**Fig. 4 - Troposphere temperature pattern according to the human-induced global warming conjecture**

More precisely, the troposphere's temperature pattern should be, according to the theory, the one displayed in Fig. 4. In it, along the $x$-axis there is the North Pole to the left, the Equator in the middle and the South Pole to the right; the altitude increases along the $y$-axis. The theory grounded on the climate conjecture predicts, at about 10 km up in the equatorial troposphere, a warming which should be at least twice the warming at the ground level. What the observations have to say on this is shown in Fig. 5, where satellite records prove that at 10 km up in the equatorial troposphere no increased warming, even less doubled, is observed. Actually, a cooling is observed.

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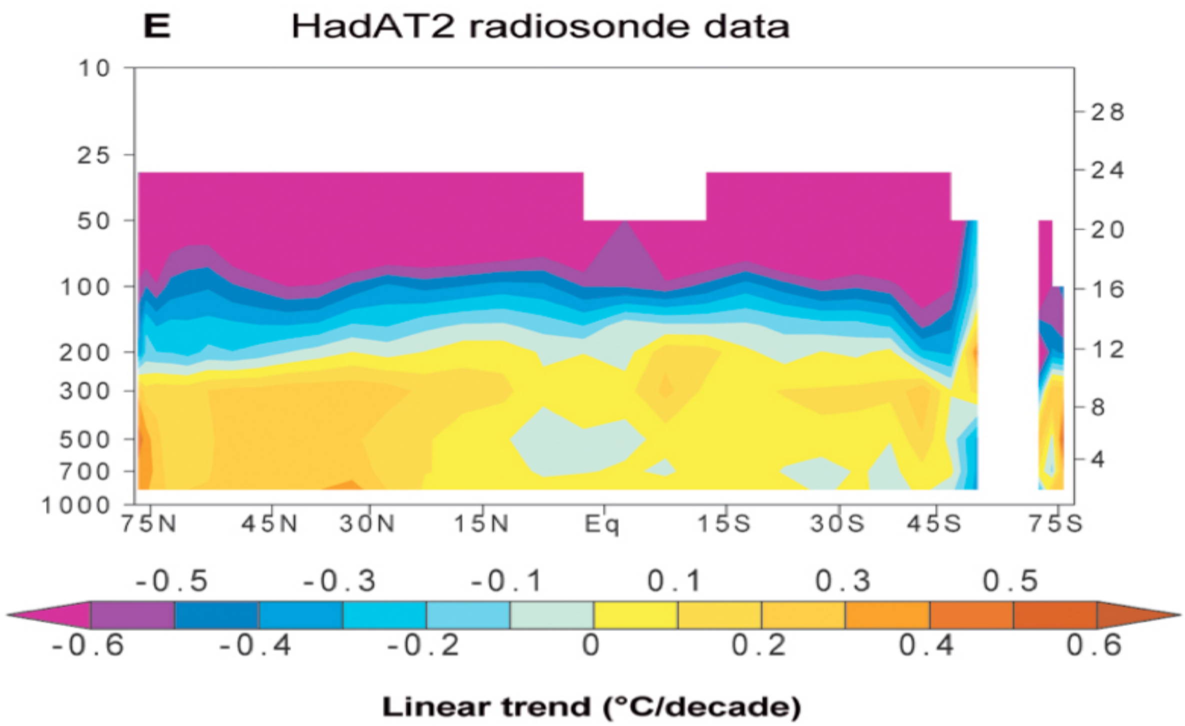


**Fig. 5 A – Troposphere temperature pattern according to satellite measurements**

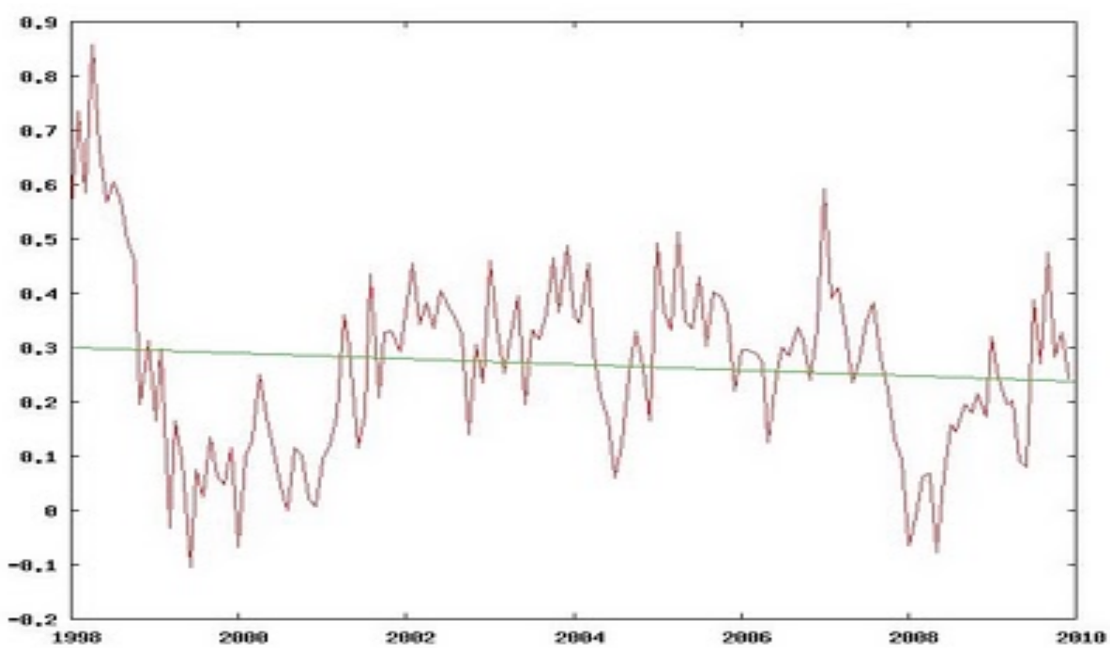


**Fig. 5 B – Troposphere temperature pattern according to satellite measurements**

6. In conclusion, striving to control the climate is a futile engagement because the climate/human connection conjecture is false. On top of that, several analyses conclude that the warming the planet has experienced during the last 400 years has had beneficial consequences. However, bad or good as the consequences of a warmer world might be, striving to reduce $CO_2$ emissions is a futile engagement, because reducing $CO_2$ emissions is an impossible task.

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## 2. Reducing CO2 emissions is virtually impossible

The Kyoto Protocol aimed at reducing CO2 emissions by 6% below the 1990's level by the year 2012. Has this goal been achieved? Not even barely: the emissions are today higher than those of 1990, as Fig. 6 shows, where you can read the world's primary energy consumption from fossil fuels (in million tons equivalent of oil) in 1990 and 2010.

According to the 20-20-20 energy package, the EU has agreed to reduce CO2 emissions down to at least 20% below the 1990 level by the year 2020. Is this goal going to be achieved? Just the opposite: the emissions today are actually higher than those of 1990. Fig. 7 shows the numbers.

| WORLD'S PRIMARY ENERGY CONSUMPTION FROM FOSSIL FUELS (CO2) | | |
|---|---|---|
| **Y ear** | 1990 | 2010 |
| **Mteo** | 7400 | 9800 |

fig. 6 – World's energy consumption from fossil fuels

| EU'S PRIMARY ENERGY CONSUMPTION FROM FOSSIL FUELS (CO2) | | |
|---|---|---|
| **Y ear** | 1990 | 2010 |
| **Mteo** | 1380 | 1400 |

Fig. 7 - EU's energy consumption from fossil fuels

You might think that the EU is on the right track to achieve the goal: after all, some reduction has indeed occurred during the last few years (mainly due to the economic crisis). Fig. 8 clarifies the point: nothing worth mentioning has really occurred.

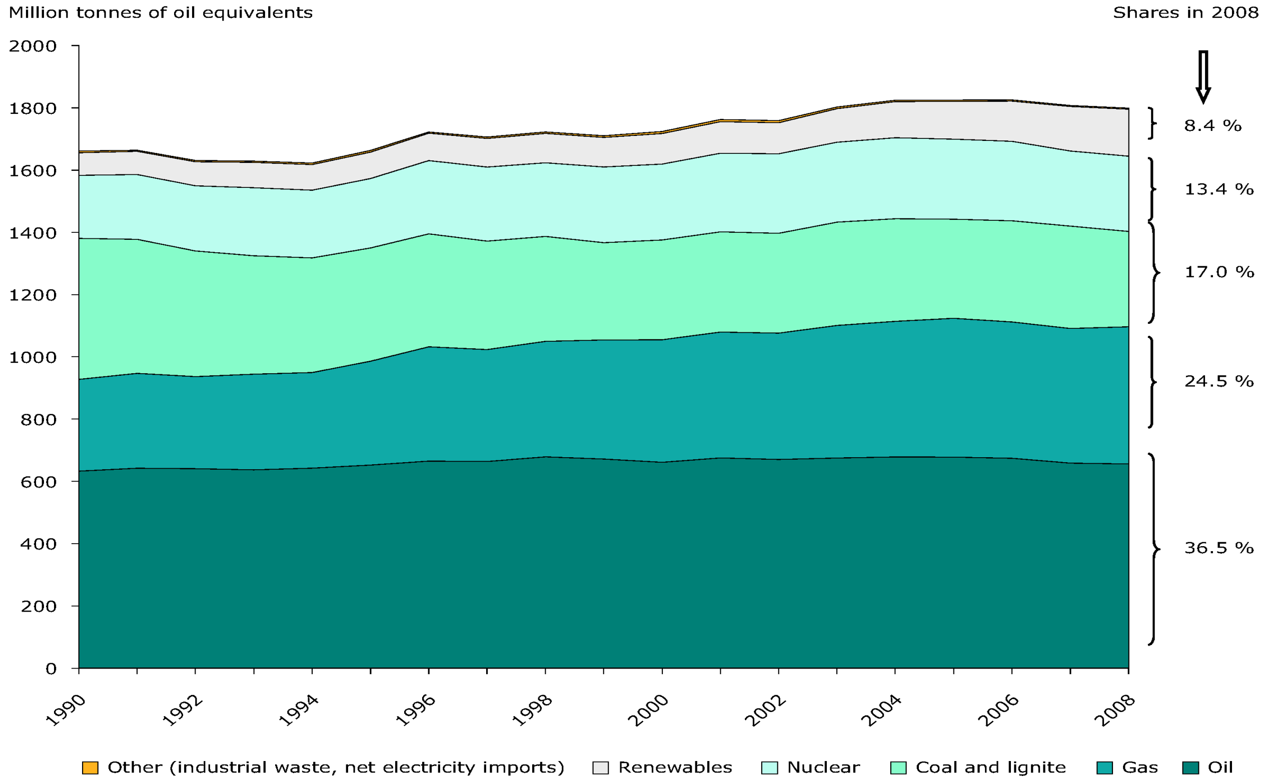


**Fig. 8 - EU's energy consumption since 1990**

The 20-20-20 EU energy package also says that the renewables contribution to the primary-energy consumption should be 20% by the year 2020. How the EU is doing on this is shown in Fig. 9, where you can see that the renewables contribution to the EU's energy consumption, which was 5% in 1990, is now less than 9%, quite far from the 20% goal.

| EU'S PRIMARY ENERGY CONSUMPTION [2010] | |
|---|---|
| Fossil Fuels | 79% |
| Nuclear | 12% (100 GW) |
| Hydro+Biomass+Waste+Geo | 6.5% |
| Wind+Solar | 2.2%+0.3% |

**Fig. 9 - EU's primary-energy-consumption share by fuels**

Is the EU doing, at least, any better than the rest of the world? Fig. 10 shows that the renewables contribution to the world's energy consumption, which was 8% in 1990, is now 9%, as much as that of the EU, after all.

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| WORLD'S PRIMARY ENERGY CONSUMPTION [2010] | |
|---|---|
| **Fossil Fuels** | 85% |
| **Nuclear** | 6% (300 GW) |
| **Hydro+Biomass+Waste+Geo** | 8% |
| **Wind+Solar** | 1% |

**Fig. 10 - World's primary-energy-consumption share by fuels**

The last "20" of the 20-20-20 EU's energy package refers to energy efficiency, which we shall comment on later. For the time being the pressing question that arises is: Why, in spite of all the commitment that the EU and the entire world have taken during the last 20 years, almost nothing has been achieved? After all, the one in Durban last year has been the COP17, the 17th *Conference of the Parties*: earnest and influential people gathered together 17 times in 17 years, but have really achieved next to nothing. Politicians have argued for 17 years without reaching any agreement on how to find €100 billion to tackle a problem that does not exist. Please keep in mind that: the fact that this year's COP in Qatar is COP18 means that there have been already 17 failures. So, the question is: Why has there been so much effort with so much failure?

The answer to the question is quite simple: no CO2 reduction is possible, not the Kyoto's 6%, even less the EU's 20%. The proof itself is astonishingly simple. Look again at Fig. 10, to understand why the Kyoto Protocol was an impossible dream. 85% of our energy consumption comes from fossil fuels, i.e., 85% of what we do is done by emitting CO2: we emit CO2 even at night while sleeping, because our refrigerators, our heating systems during the winter, our cooling systems during the summer, are at work. Almost all of whatever we do, is done by emitting CO2. From Fig. 10 you also see that all the nuclear power in the world avoids about 6% of the emissions, i.e., if there were no nuclear plants, our emissions would have been about 6% higher. As Fig. 10 specifies, their total output is 300 GW. To achieve another 6% we could then build about 300 large nuclear reactors, which would require about €1 trillion in capital investment. How many nuclear reactors are under construction worldwide? About 60, one fifth of what is needed. Notice that the economic commitment to reach this goal by means of the nuclear power is 10 times larger than the commitment on which the rulers of the world were unable to reach any agreement in 17 years.

Likewise, the EU's 20% emission reduction is impossible. Please, look at Fig. 9. There you see that nuclear power avoids about 10% of the EU's CO2 emissions, i.e., without nuclear power EU's CO2 emissions would be 10% higher. A further 20% reduction would require, at least, 100 new nuclear plants to be installed before 2020. However, the nuclear plants under construction in EU are just...2: what is being pursued is a CO2- emission reduction of not even 0.2%.

As you should have been convinced by now, little CO2-emission reduction is possible from nuclear power; which, like it or not, would be the most effective way to do so. To make things worse, consider what happens if one tries to achieve the goal without resorting to nuclear power, that is by installing wind and photovoltaic plants. We have already noticed that to produce 300 GW-electric necessary to satisfy the Kyoto Protocol would require a capital investment of €1 trillion for the 300 nuclear reactors needed. To produce 300 GW- electric from wind, wind farms of about 1500 GW capacity would be needed, with an economic burden, in capital investment, not less than €1.5 trillion (not to mention that they would be about 1.5 millions wind towers). Furthermore, to produce 300 GW-electric from solar photovoltaic (PV) technology, there should be installed a PV power of about 3000 GW, with an economic burden, in capital investment, not less than €15 trillion! In case you are wondering why to produce 300 GW we need 1500 GW in wind power and 3000 GW in PV power, the short but sufficient answer is: Because the wind doesn't blow and the sun doesn't shine 24 hours a day.

Now you understand why the 17 COPs have been 17 failures, why COP18 in Qatar, next November, will be the 18-th failure, and why no CO2-emission reduction has been achieved: **as long as we have fossil fuels available, no reduction is possible**. More precisely: meaningless reduction is presently possible with nuclear power, even less with wind power or, worse, with solar power.

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## 3. Energy, not climate, is the real problem

«As long as we have fossil fuels available», I wrote in the last sentence above. From Fig. 10 we see that 85% of world's energy consumption comes from fossil fuels: almost all we do can be done thanks to fossil fuels. Fig. 11 shows the world's oil yearly production as a function of time [R.J. Brecha et al., *Am. J. Phys.* **75**, 916 (2007) and references therein].

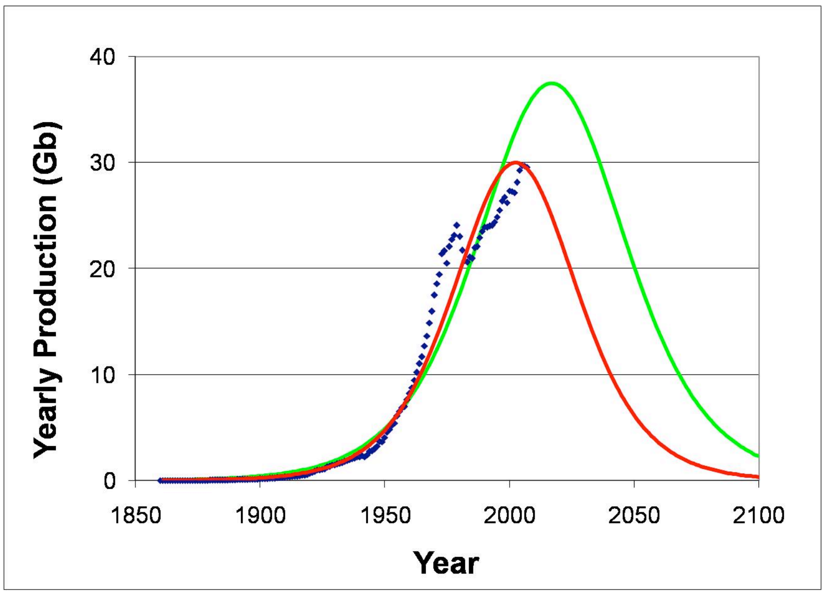


Fig. 11 - Hubbert's peak of oil

The points show the actual yearly production. The lower continuous curve is the Hubbert curve, drawn assuming a total amount of oil of about 2 trillion barrels, which is the best estimate available. By the end of the century oil production will be at the 1900 level. But the real problem is not the end of oil: The real problem will occur when Hubbert's curve will be at its maximum – Hubbert's peak – when oil demand starts to be greater than oil production: the geo-political consequences of the circumstance I shall leave to your imagination. As you can see, the world is sitting on top of Hubbert's peak. And, if the best estimate available were wrong and the total amount of oil were about 3 trillion barrels, Hubbert's peak will occur before 20 years from now, as the upper continuous curve shows: you should keep in mind that every billion barrel of oil discovered shifts Hubbert's peak by 6 days. So, either the world, sitting on Hubbert's peak, is late with the actions to be taken to minimize the consequences of the necessarily diminished oil production; or, Hubbert's peak will occur 20 years form now and, by acting now the world will avoid to the next generation the uneasy situation we could be now in case we are, after all, sitting on top of Hubbert's peak.

If you still wonder about how faithful these predictions are, let me tell you two things. First, the oil's Hubbert's peak will occur, simply because our planet is round and finite and not flat and infinite. Second, a peak (not Hubbert's peak) has already occurred for sure. Fig. 12 displays the oil production per year and per person as a function of time [A. Bartlett, *Physics Today* **57**(7), 53 (2004)].

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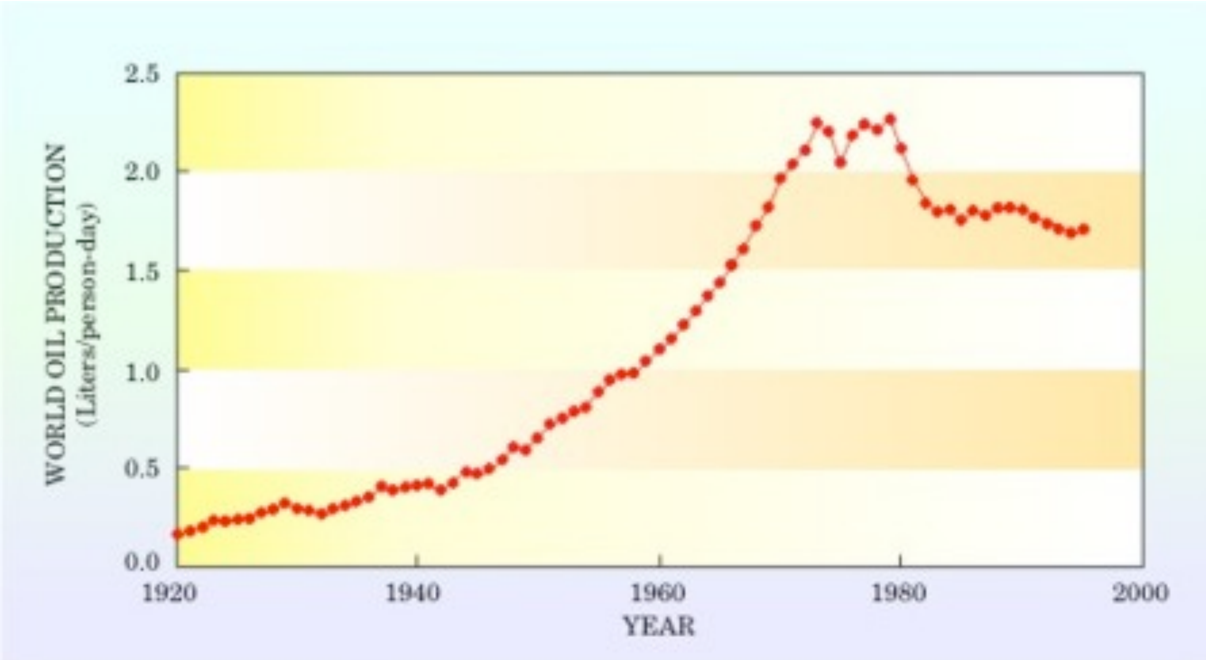


**Fig. 12 - Yearly world oil production per person**

As you can see, it is since 1980 that the world produces human beings faster than oil: please, keep that in mind. You see, 80% of the cost of what you have on your desk at lunchtime is energy cost, and, as several times noted, almost all energy we use comes from fossil fuels, half of which is oil. Modern agriculture could be defined as the transformation of oil into food: no oil, no food. Succeeding in reducing, even slightly, fossil-fuel consumption, might mean to skip breakfast for the 1 billion people living in the developed countries, but for the 1 billion people starving to death it would mean to die because of starvation.

The fact is that ours is the Oil Age. Seen in the context of the centuries, Hubbert's peak is what is shown in Fig. 13. Each civilization has been labeled with a specific symbol by the following ones: the Egyptian civilization with the Pyramids, the Greek and Roman civilizations with the Athens' Acropolis and Coliseum, and so on. Hubbert's peak is most probably the symbol how the future civilizations will label ours.

Ours is the Oil Age or, better, it is the Age of abundant and cheap energy. We should be grateful to God for having allowed us to live in it. For, during the millennia to the left of Hubbert's peak the energy needs of the past civilizations were satisfied by slavery. You should keep in mind that at the time of the Egyptian, Greek or Roman civilizations, 90% of the population was kept in slavery. Which is not a today's taboo of a thousand-years-ago habit: you should not forget that *Gone with the wind* was taking place, in America, just 150 years ago, when there were 4 million slaves within a population of 30 million citizens. Like it or not, you should realize that slavery became a taboo not because of socialist fights, but because of the invention of thermal and electric engines and devices.

What was that supplied the energy needs of the past civilizations from the Stone Age for all the millennia up to the beginning of the Oil Age, i.e., to the left of Hubbert's peak? It was solar energy, 100% solar energy, i.e., wood and slavery. Look now again at Fig. 10, which shows that today the solar-

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energy contribution (hydropower, biomass, wind and direct solar) to the world energy consumption is less than 9%. You see, then, that **solar energy is the energy of the past**: 100% for millennia until a couple of centuries ago, less than 9% today.

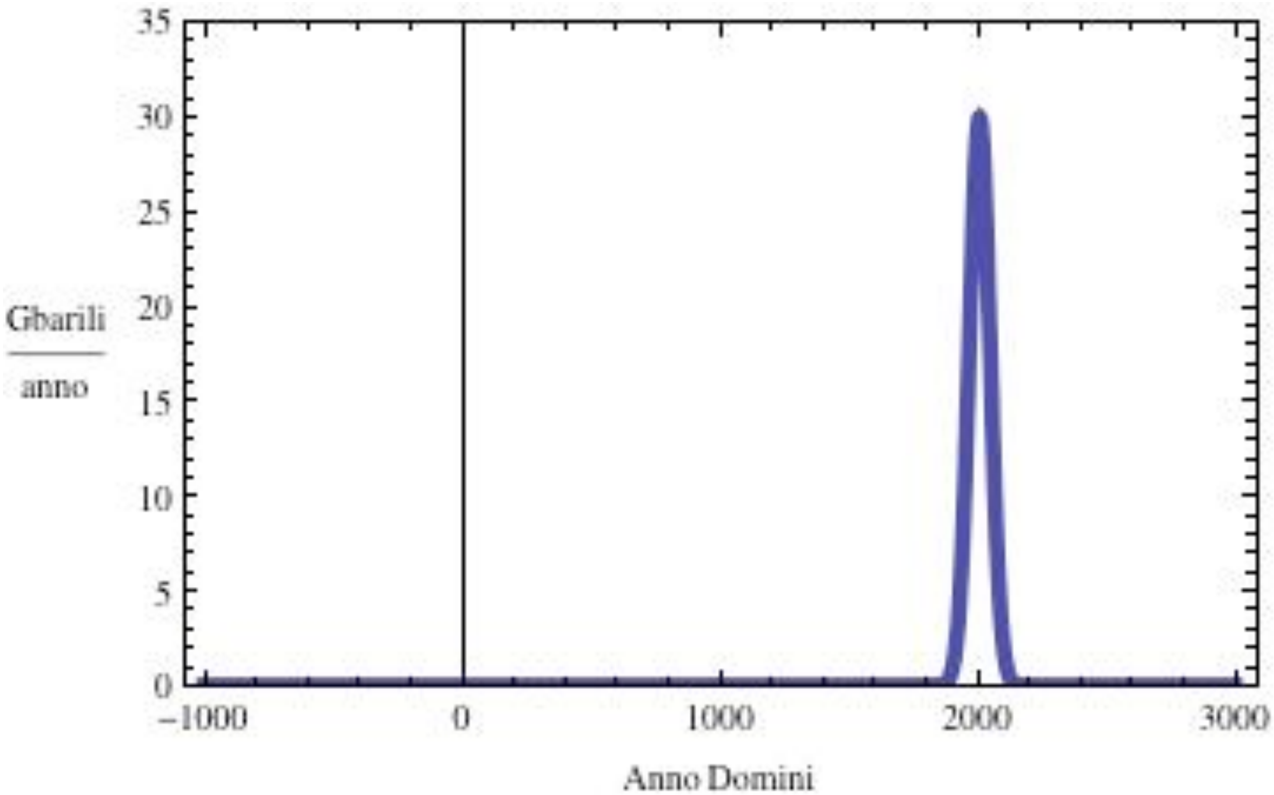


Fig. 13 - The Hubbert's peack of oil

The question then arises of whether solar energy could be the energy of the future, the energy that will feed the needs of the civilizations prospering (hopefully) to the right of Hubbert's peak. The answer is no. And it is so for technical reasons: no matter how deep goes our research and how advanced gets our technology, we cannot ask the sun when to shine or the winds when to blow. All this shall soon be clarified. Before that, let me comment on one point. The fuel of past civilization, for several millennia, has been the sun, 100% sun energy. During all those millennia when the energy needs of all civilizations have been satisfied for 100% by sun energy, the world population has been below half billion people. We are now 7 billion. **For sun energy to be the energy fuel of the civilizations prospering (hopefully) to the right of Hubbert's peak, at least 6 billions of us has to die**. You start to see, now, to where the EU's energy policy is heading.

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## 4. Wind and photovoltaic technologies are a fraud

Apart from fossil-fuel, nuclear, geothermal, and urban-waste energy, everything else is solar energy: hydropower, biomass, wind and direct solar are, all, solar energy. As has already been stressed, the fuel that satisfied the energy needs of past civilizations, since the remotest times until a couple of centuries ago, was 100% solar energy, whereas today's solar-energy contribution is less than a tiny 9%: solar energy is the energy of the past. Solar-energy technologies, however, do not contribute with similar share. Quite the contrary: of those 9 points, 8 are due to hydropower (to biomass, in poor countries; i.e., wood, is the major solar contribution in those countries, and it is so for the same reason for which wood was the leading fuel of the past civilizations for millennia).

Actually there are countries – such as Norway or Paraguay – where hydropower provides 100% of their electricity needs. Modern technologies – wind power and photovoltaic (PV) technology – are, everywhere, irrelevant. Wind power and PV contributions to the world energy needs are, respectively, less than 1% and less than 0.01% (see Fig. 10). Even in countries that have strongly committed themselves to these technologies, the contribution from them is nothing worthwhile to mention, in comparison with the effort taken. In Fig. 9 you can see the contribution of these technologies to the primary energy needs in the EU countries: 2.2% from wind and 0.3% from photovoltaic technologies. However, it is electric energy that these technologies produce, and to be fair it is with electric production (rather than with primary energy) that comparison should be made. You may read this comparison in Fig. 14: Wind and PV contribution to the EU's *electric* needs is about 5%, of which 90% from wind and 10% from PV technologies.

Germany is the country most committed to wind and PV technologies. In 2010 its installed wind capacity was about 27 GW (more than 25000 wind towers!), whereas its installed nuclear capacity was about 17 GW. And 17 GW was also its installed PV capacity: in practice, half of PV modules of the world are in Germany. However, whereas in 2010 nuclear power contributed 23% to the German electricity demand, wind contributed 6% and PV 2%. The capital investment of those wind and PV plants has certainly been higher than €100 billions: with that money Germany could have installed 30 GW in new nuclear plants that could have provided not 8% but 40% of its electric needs.

| EU'S ELECTRIC ENERGY CONSUMPTION [2010] | |
|---|---|
| **Fossil Fuels** | 51% |
| **Nuclear** | 27% (100 GW) |
| **Hydro** | 12% |
| **Biomass+Waste+Geo** | 5% |
| **Wind+Solar** | 4.4%+0.6% |

**Fig. 14 - EU's electric-energy-consumption share by fuels**

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If I gave you the impression that the problem with wind and PV technologies is that they are very expensive, I was wrong. They are very expensive indeed, but this is not their problem. It is a problem – a fantastic problem, as a matter of fact – but it is not their real problem. To understand what their real problem is, you have to understand how we make use of energy and, in particular, how electric energy works.

Energy is a good that you have to have available exactly when required; otherwise it is useless. This is why, among renewables, hydropower and biomass take the lion share: energy is stored in a log of wood, ready to be burned at will; and energy is stored behind a dam in the water, ready to make it fall on the turbines at will. On top of that, electric energy has to be produced as demanded and has to be used as produced: a slight unbalance will cause blackouts. For, we don't know how to store electric energy. And there are fundamental reasons of physics why we don't know that. I don't want to go into technicalities, but this is the reason why we don't have electric cars.

To fully understand the problem without too many technicalities, we have to consider the daily electricity demand. It is shown in Fig. 15 for Italy and for a few other countries. On the $x$ axis of both figures you can read the hours of the day, on the $y$ axis the power demanded: for Italy, it is shown the actual power, in MW;

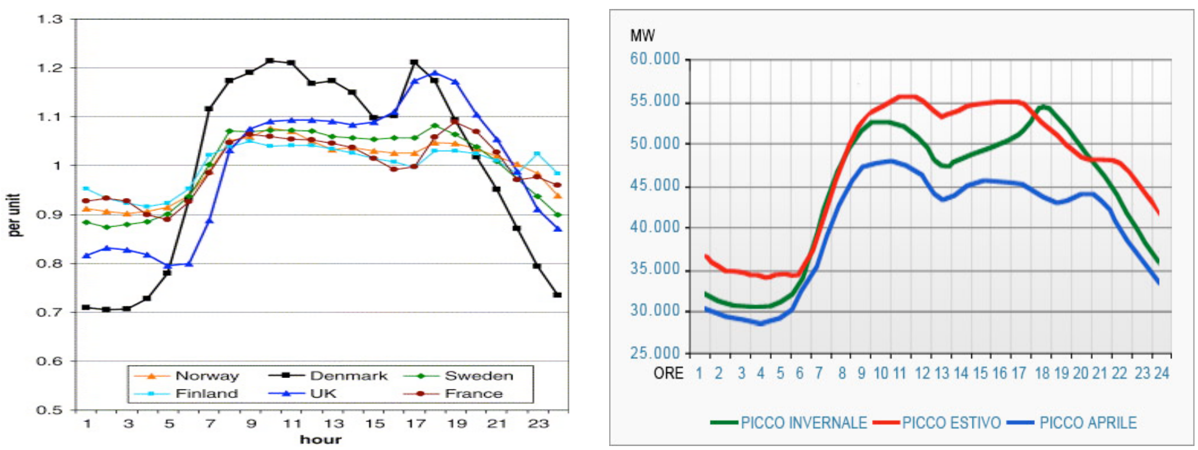


**Fig. 15 - Electric power-load curves of Italy and of a few European countries**

for other countries, the power of each country has been renormalized to its average demand, so to make a sensible comparison between the countries. The point of showing both figures is that the general pattern of these load curves is the same for all. 1) The electricity demand never goes to zero: Italy, for instance, demands at least 30 GW 24 hours a day, which is Italy's base load. As you see from Fig. 15, the base load of each country is at least 70% of its average electric-power demand. 2) There are hours of the day when the load reaches a peak, typically around 10 AM and around 7 PM.

To produce electricity according to the load curve (and it has to be so produced, otherwise the system suffers blackouts), each country may use, at will, any conventional technology (hydropower, coal, natural gas, nuclear). There are countries that use 100% hydropower (Norway, for instance), and there are countries that prefer nuclear (for instance, from nuclear power France produces 80% of its electricity consumption). However, apart from those exceptions, in general, each country has its own mix, which depends on several factors, mainly technical, but also political. It is the favourable orography and its limited population that allows Norway to use hydropower for 100% of its needs. And it is thanks to the abundant availability of coal in Germany that it is coal that provides about 50% of Germany's electricity needs. And are obvious the reasons why Saudi Arabia produces its electricity, fifty-fifty, form oil and natural gas.

Could wind and photovoltaic (PV) technology take any part in this share? Unfortunately no. Could they give any contribution to the base load (which is, by the way, at least 70% of the average demand)? Certainly not the PV technology: the base load is, by definition, the load required 24 hours a day, and the sun does not shine for half of that time. Could they give any contribution to the peak load? Again, certainly not the PV technology: one of the peaks occurs at around 7 PM, when it is dark. Well, PV modules may contribute when the sun shines, you would say. It is not so. For, in very cloudy days PV plants produce no power.

Just the same it is with wind: the electric system cannot rely on wind, which blows at its will, not ours.

The bottom line is that the electric system has to have as many conventional plants as the peak load requires. Differently said, no matter how many gigawatts you install in wind towers or PV roofs, you cannot shutdown a single watt of conventional power. You may shutdown a 1-GW nuclear reactor and put a 1-GW coal plant into operation; you may shutdown a 1-GW coal plant and put a 1-GW hydropower plant into operation (orography allowing), but you cannot install wind turbines or PV roofs for 1, 10, 100 GW and shutdown a single conventional watt.

Germany is an example for all of us. It has installed 44 GW in wind and PV power: has it, because of that, shutdown a single coal plant? No. Or did it shutdown a single nuclear plant? Actually, just the opposite: a few weeks before the 2011 earthquake in Japan, Mrs. Merkel's government had approved a life extension for several nuclear plants. Quite peculiar for a country that had spent more than €100 billions in 44 GW of "green" power. Since the Fukushima events, Mrs. Merkel, having changed her mind, has closed one third of Germany's nuclear plants, but those "green" 44 GW have been of no help: the price Germany is paying for the missing nuclear plants is that it has both increased electricity production from inland coal and imported natural gas and decreased its electric-energy export/import balance.

You see, now, that wind and PV technologies are useless: their contribution to the load curve is virtually zero. It's not a matter of costs: if the wind tower and the PV modules were free, they would be as much useless. Simply, they do not fit within the electric system. If the roofs of the European houses were all covered, by some magic, by photovoltaic modules, we would still need all the conventional plant we have now.

Allow me a metaphor. For your transportation needs it is pretty enough for you to have a car (unless you need to go overseas). Would you change your car for a bicycle? No, you wouldn't go too far. Yet, you do have a bike. Why? Because, given that a bike costs 100 times less than a car, there are occasions when the bike can do the job and you save money on gasoline. Would you have a bike if its cost were 10 times more than that of a car? I doubt. Perhaps you would, even up to the point of buying a bike instead of a car, if the bike were a reliable substitute for the car, but this is not the case. It is just the same with those "green" plants: they are, mostly, useless, even if they were free. On top of that, far from being free, they are even 40 times more expensive than conventional plants.

You now should agree with me that the only function they provide is to save on conventional fuel. Exactly as the bicycle has the merit of avoiding you to burn gasoline, the only merit wind and PV plants have is to make you saving on fossil fuels when the wind blows or the sun shines. A saving that, as I shall soon show you, has nothing to do with future-generations needs.

And here we come at the heart of our discussion: when, being to the right of Hubbert's bell, there won't be any fossil fuel to save, those "green" plants, having lost their only function of saving fossil fuels, will then be totally useless. This is why solar energy cannot power the world in the future. And you better don't bet on research and technology developments: **no research, no technology advancement will ever make the sun shine or the winds blow differently than how they do**.

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## 5. Energy saving, energy efficiency, and creating jobs

There is a lot of misunderstanding about energy saving and energy efficiency. For instance, we concluded last section by proving that the only purpose of producing electricity from wind and PV plants is to save on conventional fuel. But this is not energy saving. And, if you insist that this is energy saving, then I can show you that energy saving is a futile engagement.

If energy saving were oil saving, why should we save on oil? Perhaps, because it is our duty to give the future generations development opportunities similar to those have been granted to our generation. It was not me who made up such a good reason to save on oil, but somebody much cleverer than me, who even gave a name to the reason: *sustainable development*. *Développement durable*, to word it in French. Let's do the math, though, and compute what might the benefits be, on future generations, from our oil saving, which we would do because otherwise oil will come to an end in less than 100 years. How much savings? To settle things once and for all, let's assume that the EU saves 100% of the oil it consumes: let's say that starting from tomorrow European countries store somewhere, in a safe place, the whole oil they would have otherwise used. When, 100 years from now, the oil of the world will be gone and the European countries will open their oil repositories, given that EU's countries use less than 20% of world's oil, the one so carefully saved for 100 years will be gone in less than 20 years. The saving considered – 100%, quite draconian a choice – would affect no future generation. Even less it would any more realistic saving. Say the entire world were able to engage into a 10% oil saving. Which is quite a lot, at least twice as much as required by the Kyoto Protocol, which the world was unable to satisfy. Yet, the end of oil will come in 110 years rather than in 100 years. Once again, no future generation will be affected whatsoever.

The point is this: **it is futile to save a finite good**. I save on my monthly income to get along till the end of the month and because I know I'll get another check next month. If the one of this month were my last check, saving money or not would mean to choose to be broken by the 4$^{th}$ of next month rather than by the 30$^{th}$ of this month. If not the finite or the infinite ones, what are, then, the resources worth to save? They are those resources whose amount is infinite but whose availability is finite. Pretty much like my income: it is infinite in the sense that to me, holding a tenure position, the income is guaranteed during my whole life; its availability is finite because it is given to me quantized in monthly checks. Saving on oil is therefore meaningless, not less than such extravagant a concept as *sustainable development*.

Well, you might say, perhaps the reason why we should save on oil is because oil costs money and, after all, to save energy means to save money. I like this one: indeed, the only sensible reason to save energy is because energy, in the form that is useful to us, doesn't come upon us for free, and we save energy because we need to save money. Germany has spent at least €80 billions in installing 17 GW of PV plants whose electric production (12 billions kWh in 2010) has allowed them to save €840 millions in one year (the electric kWh is quoted about €0.07 on the stock market). I'm not an economist, so you tell me whether Germany has *saved* any money. Assuming no efficiency reduction, no maintenance costs and a (very long) life of 30 years for the PV modules, Germany will have saved €25 billions in 30 years, having spent €80 billions today.

The only rationale for saving energy is to save money. Apparently, however, the green economy achieves everything but saving money. Actually, it pretty well succeeds in wasting huge amounts of taxpayers' money.

Some people mistakenly identify energy saving with not wasting it. Wasting energy means to burn fuel when not needed, an occurrence too trivially contemptible to worth mentioning, and saving energy cannot be such a trivial proposal, given that it seems to be at the center of the political agendas of the rulers of the world. No, saving energy cannot mean to avoid using it when not needed, rather must mean to avoid using it when needed. But this is exactly what makes us poorer. As said, whatever we do, is done by using energy, i.e., nowadays, by burning fossil fuels. To ask us to spare on energy use means to ask us to accept to be poorer and lower our well–being. It means to lose jobs and to take back the path toward slavery. **Saving energy is the most dangerous maneuver we could ever make**. To appreciate this statement, please look at Fig. 16, where you can see how economic wealth is correlated with energy use.

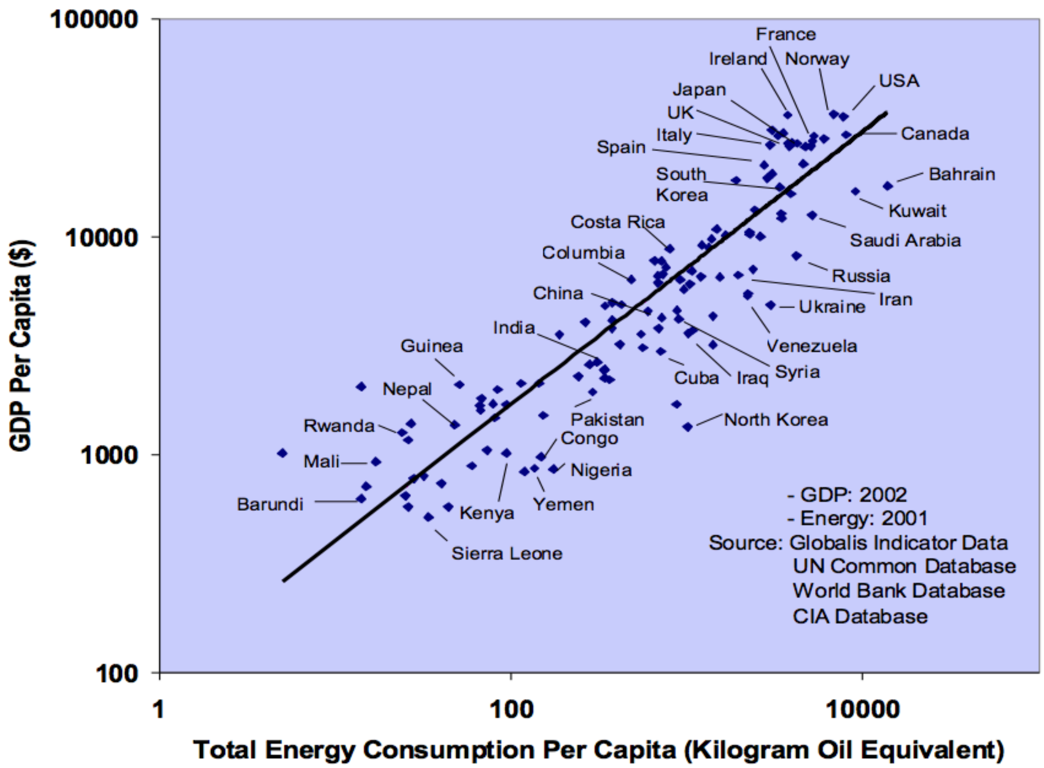


Fig. 16 - Economic wealth is highly correlated with energy use

Some people mistakenly identify energy saving with energy efficiency. EU's rulers do. It is not clear what they mean. Our energy production and energy consumption devices are already quite efficient, very close to their upper bound limit. An *ideal* thermal engine that works between a source 1000 K and a sink at 300 K, has a 70% efficiency, but *ideal* engines do not exist. A less idealistic, yet *theoretical*, thermal engine that works between those temperatures has a 55% efficiency, but *theoretical* engines do not exist either. Our thermal engines are 45% efficient, pretty close to the theoretical limit: we can hardly go any further; we cannot go against the laws of physics. We could still make a slight improvement, but nothing to get excited about, nothing which to build an energy policy on. People interested into energy policy like to define the energy efficiency of a country as the ratio between the gross domestic product and the primary energy consumption, so that energy efficiency sounds as "getting more with less energy". All this is fine, and I do promote energy efficiency. However – and this is my point on the matter – I'm aware, and you, too, better be aware, that as good as energy efficiency might be, it worsen our real problem, which is Hubbert's curve, displayed in Fig. 11. It is not hard to see why.

Whenever a good is available with an increased efficiency, the use of it increases, too. Since we have had a very efficient system of sending and receiving letters – the email service – we all receive and send a larger number of letters than we used to in the past. Since we have had a very efficient system to make phone calls – the cell-phone technology – we all make and receive more phone calls than we used to in the past. Just the same is with energy: once we have been able to manufacture very efficient refrigerators, we started putting a deep-freezer next to them. And if cars were today still as efficient as those of 100 years ago, almost nobody would have a car, and a lot of oil would have been saved. The bottom line is that a higher efficiency in energy production or energy consumption is an excellent goal to pursue but, inevitably, will have the consequence of increasing the energy demand. We can see from facts that this is so: during the last 15 years, developed countries have improved their energy efficiency at a 1.3% per year rate, but in spite of that those countries, during the same period, have increased their energy consumption at a 1.7% per year rate. Not *in spite* of that, but *because* of that, we should better say. Please, be aware of this: energy efficiency will shift Hubbert's peak to the left, i.e., will make worse our real problem. Yet, I wish to stress it here, energy efficiency is a lovely goal to pursue. For, by wisely increasing our energy consumption we increase our well–being.

A quick comment on creating jobs is due. The urban myth is that those green-economy plants create jobs. First of all, you should realize that **it is not by producing energy but by consuming energy that jobs are created**. Otherwise it would be easy: just provide a bicycle to a million unemployed asking them to pedal, thereby producing electric energy. It doesn't work this way. Second, dreaming of creating jobs committing ourselves into technologies that we have proved to be useless is like dreaming of creating jobs asking people to dig graves during daytime and to fill them up again at night. It doesn't work this way, either: those people might have an income, but society would hardly get wealthier.

## 6. What to do?

I will answer the question limiting myself to the electric energy sector, and have chosen to do so for two good reasons: 1) it is an important sector of our energy budget: about 40% today, but possibly and hopefully growing in the future; 2) it is this sector where the EU's energy policy is making the greatest disaster, by promoting all those totally useless and tremendously expensive wind farms and photovoltaic roofs.

The answer to the question can be given by looking at Figs. 15, 17 and 18. Fig. 17 shows the capital investment for a plant producing 1 GW electric, whereas Fig. 18 shows the relation among fuel's prices.

| PLANT'S COST TO PRODUCE 1 GW ELECTRIC | |
|---|---|
| Natural Gas | 1 G€ |
| Coal | 2 G€ |
| Nuclear | 3 G€ |
| Wind | 5 G€ |
| Photovoltaic | 50 G€ |

**Fig. 17 - Plant's cost to produce 1 GW electric**

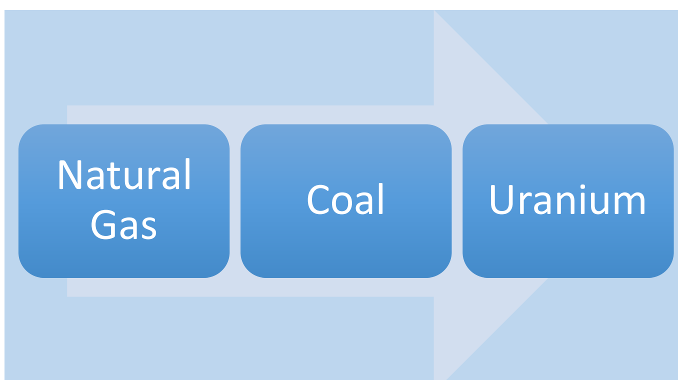


**Fig. 18 - Relation among fuel's prices**

The rules to follow for a wise energy policy then are:

1. Stop installing wind farms and PV roofs. As seen, they provide zero capacity to the electric system. On top of that, their intermittency creates undesirable stability problems. Economically, they are of no help because the conventional utilities must be there anyway, ready to go into operation whenever the wind stops to blow or the sun stops to shine, a circumstance that requires us to pay anyway for those utilities, even when they do not produce, if we want them to be there for us. From all the above, we can conclude that wind farms and PV roofs should not

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be installed even if they were free. However, this is not exactly what they are, as Fig. 17 shows.

2. Install as much hydropower plants as the local orography allows. Hydropower is the only meaningful renewable-energy technology.
3. Install as many nuclear plants as necessary to cover the base load. Nuclear plants are the most expensive conventional plants. However, they burn the cheapest fuel, whose availability is for thousand years. Also, the technology requires them to work continuously, which is what the base load requires, a circumstance that allows the quickest returns for the plant investments. For instance, a 1.2-GW nuclear reactor costs about 3 G€ and produces about 1 GW electric. During its 60-years life, it will have produced about 60 GW-year of electric energy, amounting to more than 500 TWh. At a price of 7 c€/kWh, this means revenues in 60 years of about €40 billions against the initial investment of €3 billions (it is worthwhile to mention at this point that less than 15% of the nuclear kWh's production costs are fuel's costs). The base load is, for each country, about 70% of the average consumption (Fig. 15). For instance, Italy's electric consumption amounts to 40 GW, and Italy's base load is indeed 30 GW. Italy, then, should have about 30 GW nuclear, i.e., about 30 nuclear reactors. As for EU, its electric consumption amounts to about 380 GW: it should have not less than 250 GW nuclear, whereas its electric production from nuclear is about 100 GW. Therefore, the EU should plan to install about 150 nuclear reactors (30 of them, as said, should be in Italy). By the way, by doing that the aimed 20%-CO2-emission reduction would be achieved.
4. Install coal plants to cover the regular load above the base load. Coal is an abundant resource, easy to transport. Coal plants are not as expensive as nuclear ones and coal is cheaper than natural gas. Nuclear and coal should provide, respectively, 50% and 30% of the electric-energy needs.
5. Devote natural gas only to supply the peak load. Gas plants (together with hydropower plants) are easy to be put quickly into operation and because of this very well fit the electric demand at the load's peak. The relative low cost of the plants and the relative high cost of the fuel makes gas plants best suitable to work, together with hydropower plants, as a "cold-reserve" for the exceptional peak demand. Not only natural gas is a costly fuel, but it is also a precious resource, which would be better to reserve for transportation uses. For a similar reason, oil should not be burned to produce electricity: it is a costly and precious resource, of which the petrochemical industry knows how to make a better use.

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## 7. Conclusions

In conclusion, **the ideal energy mix for electric production would be: 50% from nuclear, 30% from coal, 15% from hydropower and 5% from gas**. The 2010 EU's electric-energy mix is shown in Fig. 15, where the fossil-fuel contribution is 30% from coal and 20% from natural gas. A wise policy would be to reduce natural gas in favour of nuclear. The real policy being pursued has been 1) to waste huge amount of money into the useless green-economy plants, in the futile attempt of ruling the climate, and 2) to irresponsibly slow down on nuclear, with the inevitable consequence of increasing the use of natural gas. By pursuing such a policy EU's leaders are digging our grave.