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Terrestrial Energy Imbalance

Diagnosis and Treatment Two Sides of the Same Coin

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Abstract: The aim of this work is to delve deeper into the two main causes of the Terrestrial Energy Imbalance identified so far, Greenhouse Gas and Albedo, through a comparison of data relating to VENUS, EARTH and MARS, to find the most effective actions to counteract the Terrestrial Energy Imbalance.

Keywords: *Albedo, Decimals, Energy, GHG, Harmony.*

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I. INTRODUCTION

In the publication [2] has been introduced after a Recalculation the amount of Solar Energy Imbalance or SRI that together with Anthropogenic Heat Emission or AHE, can be considered the problem that we have to solve: the Total Energy Imbalance or TEI.

This value is expected to grow until the amount of our positive countermeasures will be equivalent to the growth of Imbalance itself.

Considering the presence of Earth's Thermal Inertia Time, more time pass without positive countermeasures, less time Will remain before the Temperature increase will reach the threshold for marine ICE formation possibility i.e. -1.8 C°, with the consequence of no more floating ICE and associated Ocean currents, a very important tipping point for Survival.

Until now a global recognized and accepted scientific diagnosis regarding the main cause of global warming Is still missing.

Therefore, I believe that examining the diagnosis in greater depth is essential to proposing the most appropriate solutions.

II. METHOD

Since the Earth belongs to the Solar System, I decided to analyze the conditions existing on the planets closest to Earth, Venus and Mars, to search analogies or discrepancies in relation to SRI problem.

In [6] [7] [10], I have obtained the physical characteristics currently available for the three planets.

Table 1 Venus, Earth, Mars: General Characteristics

Data	Planets		
	VENUS	EARTH	MARS
Mean Radius, MR km	6,052.0	6,371.0	3,390.0
Surface Pressure, Pkg/cm²	92.0	1.0	0.00628
CO2 %	96.5	0.042	96
Surface Gravity, Gm/sec²	8.9	9.8	3.7
SUN Distance, AUAU= ~149.6•10⁶ km	0.72	1.0	1.52
Mean Orbital Radius, MOR km	107.7•10⁶	149.6•10⁶	227.4•10⁶
Bond Albedo, 0=100% Light absorbed 1=100% Light reflected	0.76	0.294	0.25
Surface Temperature C°	+454	+14.7	-60

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III. DISCUSSION

The first point concerns the Greenhouse Gas, GHG Carbon Dioxide or CO2 present on the planets.

For Earth, with a very low percentage of CO2 compared to the rest of the atmosphere, it is necessary to multiply the value related to 420 ppm = 0.042% = $2.15 \cdot 10^{15}$ by the ratio between the "numbers of moles" of CO2 and that of dry air, i.e. 44.01/28.97 = 1.52.

For Venus and Mars, this step is not necessary, given the high percentage of CO2 present in their respective atmospheres.

Table 2 CO2: Comparison Results

Data	Planets		
	VENUS	EARTH	MARS
Spherical Surface, SS=$(MR \cdot 10^5)^2 \cdot 4 \cdot \pi$ cm²	$4.6 \cdot 10^{18}$	$5.1 \cdot 10^{18}$	$1.44 \cdot 10^{18}$
Atmosphere Weight, AW=(P•SS) kg	$4.2 \cdot 10^{20}$	$4.2 \cdot 10^{20}$	$9.0 \cdot 10^{15}$
CO2Weight, CO2WCO2W=(AW•CO2%) kg	$4.1 \cdot 10^{20}$	$3.3 \cdot 10^{15}$	$8.6 \cdot 10^{15}$
CO2 Mass,CO_2M = (CO2W/G)	$4.6 \cdot 10^{19}$	$3.4 \cdot 10^{14}$	$2.4 \cdot 10^{15}$
Mass Ratio CO2 Respect to Earth MR=(CO2M/$3.4 \cdot 10^{14}$)	$1.3 \cdot 10^5$	1.0	7.1
SS Ratio, Earth respect to Planets, SSR=($5.1 \cdot 10^{18}$/SS)	1.1	1.0	3.5
Transfer Ratio CO2M from Planets to Earth TR=(MR•SSR)	$1.45 \cdot 10^5$	1.0	24.85

Considering the CO2 mass of Mars, on the Earth should be equivalent to: (0.042%•24.85) =1.04% of CO2.

With the average Martian surface temperature of -60°C, I am not able to suppose any relationship between Earths's increasing CO2 concentration and rising of temperatures.

Comparing Venus and Earth results, the Mean Incremental Temperature Ratio, MITR should be:

MITR= (454°C-14.7°C)/ ($1.45 \cdot 10^5$) =0.003°C,
Related to 420ppm on Earth.

Related to increase CO2, (420ppm-250ppm) =170ppm:
MITR= (0.003°C •170/420) =0.0012°C.

Continuing the CO2 emissions analysis, I have taken in consideration the increasing of CO2 connected to the increase in world population during the period 1712÷2024, and from [12] I extrapolate cumulative presence of ~$695 \cdot 10^9$ people, that with an average per capita consumption of 2200÷2400 kcal associated to a daily emission pro capita of 1 kg of CO2, should correspond to:

$(1 \cdot 365.25 \cdot 695 \cdot 10^9) = 2.54 \cdot 10^{14}$ kg = $0.254 \cdot 10^{12}$ ton.

Related to Energy Consumption and CO2 emissions, in [11] there is a relationship equivalent to 2.5, which allows to calculate total CO2 relative emissions.

Total Energy Consumption from 1712÷ 2024, is
~$772 \cdot 10^9$ toe.
Hence $772 \cdot 10^9 \cdot 2.5 = 1.93 \cdot 10^{12}$ tons of CO2.

The Total Anthropogenic Amount of CO2 emissions from 1712 up to 2024, are therefore equal to:

$(1.93 \cdot 10^{12} + 0.254 \cdot 10^{12}) = 2.18 \cdot 10^{12}$ tons.

It becomes evident that Major contribution come from Energy Production Systems equivalent to 88.5%, and very important, It CAN BE CHANGED, because It Is related to our Life Style, while 11.5% Is ABSOLUTELY necessary for Human Life.

The total measured CO2 increased weight in the atmosphere corresponds to:

$(3.3 \cdot 10^{15} \cdot 170/420) = 1.33 \cdot 10^{15}$kg=$1.33 \cdot 10^{12}$ton

Difference between emissions and the increase related to 250ppm, that is (2.18-1.33) •10^{12}=$0.85 \cdot 10^{12}$ton,

Represents emissions reabsorbed by ecosystems equal to (0.85/2.18) = 39%

As time goes by, the fundamental role played by Carbon Dioxide in the Life Process is acknowledged, because allow Autotrophic Organisms to chemically store Solar Energy through the Chlorophyll Process in the form of carbohydrates and sugars and releasing Oxygen during the day, a gas equally vital to living beings.

This process is not only essential for overall life on Planet Earth but, in my opinion represents one of the keys to Future Survival: it is not a coincidence that in the evolution of Animal Life, the Plant Kingdom plays a Primary and Irreplaceable role.

The second point concerns SOLAR RADIATION IMBALANCE SRI, relate to Albedo modification.

The starting point is the calculation of the Total Energy constantly produced by the Sun.

Outside the Earth's atmosphere at a distance of 1 Astronomical Unit or 1AU from the Sun, Solar Radiation SR has been established in [8], and correspond to:

SR = $1.361 \cdot 10^3$ W/m²

1AU = ~$149.6 \cdot 10^6$ km = ~$149.6 \cdot 10^9$ m.

Mean Earth's Orbital Surface MEOS

MEOS= $4 \cdot \pi \cdot R^2 = 4 \cdot \pi \cdot [(149.6 \cdot 10^9)^2] = 281.2 \cdot 10^{21}$m².

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Total Solar Radiation TSR =SR•MEOS

$TSR = (1.361•10^3) • (281.2•10^{21}) = 382.8•10^{24}$ W.

From TSR, currently considered a constant by astronomers, the Planets Sun Radiation can be calculated.

Table 3 Solar Radiation Comparison Results

Data	Planets		
	VENUS	EARTH	MARS
Mean Orbital Radius, MOR m	$107.7•10^9$	$149.6•10^9$	$227.4•10^9$
Orbital Surface, OS=(MOR²•4•π) m²	$145.8•10^{21}$	$281.2•10^{21}$	$649.8•10^{21}$
Sun Radiation, SR=(TSR/OS) W/m²	$2.6•10^3$	$1.361•10^3$	$0.59•10^3$
Mean Radius, MR m	$6.052•10^6$	$6.371•10^6$	$3.39•10^6$
Apparent Surface, AS=(MR²•π) m²	$115.1•10^{12}$	$127.0•10^{12}$	$36.1•10^{12}$
Incident Radiation,IR=(SR•AS) W	$299.3•10^{15}$	$172.8•10^{15}$	$21.3•10^{15}$
Absorbed Radiation, AR=[IR•(1-Albedo)] W	$71.8•10^{15}$	$122.0•10^{15}$	$16.0•10^{15}$
Specific Radiation Absorption SRA, (AR/AS) W/m²	~624.0	~961.0	~443.0

Regarding the radiation absorbed due to the Albedo effect, one figure immediately stands out:

Earth has the highest SRA associated with an average temperature of +14.7°C which is between the extremes of Venus and Mars, both planets unsuitable for life as we know.

What accounts for this truly unique situation, allowing Life Evolution as we know it today?

The answer to this question lies at the heart of the matter. Based on my knowledge, I believe that several factors all interconnected represent the answer. The presence of Constant Sunlight, the only source of Life. The presence of Autotrophic Terrestrial and Marine Organisms consisting primarily of the Plant Kingdom, the only ones capable of chemically transforming and storing a portion of this solar energy as nourishment for Heterotrophic Organisms through the Endothermic Chlorophyll Process. Other parameters to consider are terrestrial and polar marine glaciers masses, and forests/deserts extension. The variations of these factors, tends to converge toward an overall reduction in Albedo, which has been detected and measured by satellites dedicated to this purpose [5] starting from year 2000. I believe that Earth's Albedo is the needle in the balance of Thermodynamic Equilibrium throughout the history of Earth's evolution, creating the conditions for the development of Life, Glaciations or Global Warming.

The TEI value was divided between the two main causes known to date:

$$TEI = AHE+SRI = (31•10^{21}+351•10^{21}) = 382•10^{21} \text{ J},$$

That express in other form is AHE=8% and SRI=92%.

The fundamental question Is related to the factors that led to this critical situation. I believe we should first consider human behavior, which since 1712 has altered the Harmony of Earth's Main Vital Parameters. First and foremost, the terrestrial glaciers and snowfields reduction indicated in [1], equal to a volume >$9•10^3$ km³, equivalent to present Germany extension of $356•10^3$ km² for a height of 25 m. With a global lost height of 14 m, extrapolated from data in [1] and with the same volume, the base area of a Cilinder is $642•10^3$ km². I think that a geometry to represent the melting of terrestrial glaciers and snowfields Is that of a hypothetical sphere ice cap [8] spread over Earth's surface. With a height of 14 m and the volume of $9•10^3$ km³, the theoretical base area of the ice cap is $1.29•10^6$ km². That means the terrestrial Lost of surface glaciers or snowfields, with Albedo=~0.8, Is a value between $642•10^3 \div 1.29•10^6$ km² The soil that replaces this Lost has an average Albedo=~0.17. It becomes evident that the impact of terrestrial snow and glaciers reduction play a very high role in Albedo reduction: from 20% to 83%, more than 4 times.

In [5] It Is reported the albedo trend from 2000 to 2024, measured by the Ceres satellite system.From this, I deduced the current annual trend of Albedo from 2024÷2010 corresponds to approximately:

(0.287-0.293) = -0.006%
-0.006/14 years = -0.00042857%

The Minimum Solar Radiation MSR to stabilize the Albedo in 2024 is:

$$MSR = 1.361•10^3 • 0.00042857 = 0.583286 \text{ W/m}^2$$

The Annual Exposure Time AET is:

$$AET = 60"•60•24•365.25 = 31.5576•10^6 \text{ sec.}$$

The Earth's surface as seen from the Sun corresponds to the Apparent Surface area AS = $127.0•10^{12}$ m².

The product AET•AS = Constant K = $4.0•10^{21}$ m²sec.

Therefore, the value of the Annual Equilibrium Solar Radiation (AESR) in 2024 is:

$$AESR=MSR•K=0.583286•4.0•10^{21}=2.35•10^{21}$$
(W/m²• (m²sec) =W sec= J)

Assuming reflective surfaces with an albedo of 0.8, average clear sky period of 5 hours,for 365.25 days a year,and average angle of incidence of 45°, or cos = 0.7, we need to build a Reflective Surface equal to:

$$[2.35•10^{21}/ (1.361•10^3•0.8•60•60•5•365.25•0.7)] =$$
$469•10^9$ m² = $469•10^3$ km².
(W sec / ((W/m²) •sec) = m²

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In [5] I have found that exist an installation in Spain, of Artificial White Surfaces equivalent to 400km², located at Latitude 36.75°, or cos=0.8.

Considering from the Sun point of view, that means in first approximation: 400•0.8=320 km².

This corresponds to a total number of:

$(469•10^3\ km^2/320\ km^2) = \sim 1.47•10^3$ installations.

Since we need to reverse the Total Energy Imbalance, we need to increase AESR value.

With a value of $3.5•10^{21}$ (W sec= J) we theoretical need:

$[469•10^3 • (3.5/2.35)] = 698•10^3\ km^2$
Hence $(698•10^3\ km^2/320\ km^2) = \sim 2.18•10^3$ installations.

Considering $3.5•10^{21}$ (W sec=J), we need approximately:

$[382•10^{21}/(3.5•10^{21}-2.35•10^{21})] = \sim 332$ years
to reset the TEI.

However, only after the complete installation and the period due to thermal inertia it will be possible to estimate with greater accuracy the extension of the reflective surfaces required for this purpose, certified by the satellites system control, and the consequent time span necessary to bring the temperature of the ocean's currents and the ice masses back to a safe level, that was present in the period up to 1712.

Everybody on the Earth will see the Change because the snow and ice extension will start to increase.

Considering the Loss of Terrestrial Glaciers Surfaces of $642•10^3 \div 1.29•10^6$ km², the values of:

$(400km^2•2.18•10^3) = 872•10^3\ km^2$ seems to be reliable, and compared to present population is equal to:

$(872•10^9\ m^2/8•10^9) = \sim 109\ m^2$ pro capita.

Errors and omissions accepted, I believe this is still feasible.

IV. CONCLUSIONS

The effects of CO2 on temperature variations based on the reported results, confirms the conclusion I have made in [4] that Is: GHG represented from CO2 is not so important compared to AHE influence on Ocean Temperature variation. We Need to encouraging the reforestation process to restore the plant kingdom, CO2 reduction will be the Natural consequence. Increasing knowledge tends to attribute greater importance to other GHG such as water vapor, N2O, CH4 or methane, sulfur hexafluoride, hydrofluorocarbons, and perfluorocarbons. The important thing will be to quantify the relationship between the percentage of GHG's considered and temperature variation. For the SRI analysis, the observation point, according to Nicolaus Copernicus's thinking, is located at the center of the Solar System. The value of the effective surface area will depend on the position on the Earth's spherical surface with respect to the angle of incidence of solar radiation.

The angle of incidence varies continuously throughout the solar year due to the Earth's two main motions: the daily rotation around its axis and the annual rotation around the Sun, with Earth's axis tilted 23.44° from its orbital plane. A general deduction: if there were no tilted Earth's axis with respect to the orbital plane, the surface extension of the polar caps seen from the Sun would correspond to half, because the other half would constantly be found in shadow or night zone.This consideration, suggest that the most efficient location of Artificial Reflective Surfaces is between Tropics and Polar Circle. Living in a world with omnipresent and varied needs, ranging from newborn creatures to those at the end of their life on Earth, it becomes essential to propose solutions that, while respecting these multiple necessities, have as their ultimate goal the reversal of the ongoing warming process without introducing drastic changes in lifestyles, except for collective improvements.

Drawing on personal experience in the field of mechanics, It Is possible to reverse the rotation of a mechanism or a Systems, by inserting an additional gear known as "idle gear," without altering the overall functioning of the system itself, but only reverse the direction of rotation or motion.

Applied to global warming, this can be achieved by creating artificial reflective surfaces that allow Albedo values to be brought to the level of Thermodynamic Equilibrium.

In [5] has been reported a concrete reality, which began in the post II World War period, linked to the agricultural development that took place in Spain, in the Valencian Community of Almeria, in El Ejido.

In my opinion, is a step in the right direction: reflecting light energy into space, instead of preventing it from reaching the Earth's surface. The only necessary request is to have Clear Blue Sky.

This area, now covering ~400 km², has achieved multiple effects, such as reducing desert areas, transforming them into agricultural areas for food production, and simultaneously lowering local temperatures.

Artificial creation of reflective areas lost over the last three centuries represents the first step towards thermodynamic equilibrium.

Furthermore, astronomers predict that the Sun will emit more energy during its evolution, so we should prepare to address this problem now, by creating these additional reflective surfaces.

This solution, which modifies the Albedo, has always been Nature's solution to maintaining Earth's thermodynamic equilibrium, or as in the Ice Ages to lower temperatures.

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A critical question regarding attempts to limit incoming solar energy with GHG, concerns the fact that this solution would block the same energy reflected by the Albedo effect.

One of the main questions regarding this point, is the Unknown influence on Atmosphere very complex circulation systems and long terms effects.

Besides we do not need to create the very dangerous situations like for instance during Vulcano's eruptions, that are famine, desertification and all the creation of further survival problems, already critical in itself today.

It is necessary to reduce the problems and we do not need to add anymore.

In my imagination, I can see that we can change the Albedo as needed, simply by keeping the feet on the Ground, and modifying in real time the Terrestrial Albedo level like in a chessboard or leopard-spot pattern.

This remembers me the solution proposed by James Lovelock, with the creation of the educational program called "Daisy World".

Incoming Solar Energy is not the problem: it is the Source of the Whole Life.

We must never forget to asking questions, but above all, we must rehabilitate error: it represents the force that drives us forward.

The famous maxim is: we learn from our mistakes.

It Is no more acceptable to consider the value of Albedo with only three decimals point: in my opinion this value should be expressed with at least six or even more decimal points.

If we do not do it, we lose the necessary sensitivity to understand and manage the countermeasures [5].

This necessity Is the direct consequence after the official publication from [3], related to the correct value of 1Quadrillion BTU = 10^{15}BTU.

The conclusion proposed in [4], "…we CANNOT produce MORE HEAT than our PLANET is ABLE to TRANSFER into SPACE…" referred to AHE Lifestyle, should be completed with "and to dissipate the SRI, depending from Natural or Human Albedo modification".

In conclusion, the Analysis and Proposed Solution presented, are based on the scientific-mathematical method that I have tried to apply to every aspect of the analysis without any bias and which is rooted in the following fundamentals:

"We cannot solve our problems with the same level of thinking that created them."

Albert Einstein, German-born theoretical physicist.

"The task is not so much to see what no one has yet seen, but to think what no one has yet thought, about what everyone sees."

Arthur Schopenhauer, German philosopher.

"When something scares you, take its measure. You'll realize it's a very small thing, after all."

Renato Caccioppoli, Neapolitan mathematician.

"We are, all of us, the legitimate heirs of the sum total of human wisdom." Raimon Panikkar, Spanish-Indian Catholic priest and theologian.

We cannot change the past, but we can decide how to move forward. Today's choices are the cause of future results. It all depends on us. Harmony and Peace.

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