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Energetic Options to Sustain the Planetary Economy

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Abstract: In the paper "The man made global warming. Energetic scenarios" published by AJEP-USA

has been considered a new economic approach for the proliferation in the whole world of wind power system which

1. Produces on demand energy consumed by 12 billions consumers
2. Reduces the climatic effects due to fossil derived energies consumed
3. Offers energy at prices lower than 43 USD/BOE

The year 2081 is presumed that in which the growing number of the world's consumers population has depleted 1240 billion TEP considered reasonably consumable fossil energy reserves in the year 2017.

Than at 2081 year an energetic substutive system has to be operative.

In the paper the analysis is focused in all the causes of climatic changes by considering also the contribution of the living animals.

A +17.7% of infrared reflecting gases in excess in the atmosphere is obtained when the whole effect of fossil derived energy is cancelled.

This giustify all the efforts to cancel the disruptive effects derived from fossil energies consumptions.

To do this have to be considered

1. The reserves of substutive energies
2. How to amortize the investments
3. The programs of planetary security
4. The tarifs of the energy sold
5. The necessary time lenghts

The proliferation in the world of energy producers which can be considered are:

20800000 MWe of thermoelectric nuclear convertors

90912394 MWep of wind power convertors.

They produce 104000 billion KWhe/year which are consumed as a liquid and gaseos fuels, heat, electricity (pro capite energy consumed 2.3 TEP/year at the year 2100)

The wind reserves are materials extracted from earth's litosphere, while the earth is poor of nuclear reserves, but the breeder convertors as well as the promise of fusion convertors can lengthen the time duration of nuclear reserves.

By using the data of A. McDonald (Energy in a finite world. Executive summary May 1981. IIASA A2361 Luxemburg, Austria) for nuclear reserves, and the data published by Bruni G. (1957, Chimica generale ed inorganica – Libreria editrice politecnica Cesare Tamburini Milano) for wind reserves, the results of this analysis are resumed in the following table

Table – *ratio between nuclear reserves to wind reserves (energy produced 26 billion TEP/year)*

U238	3.83×10^{-8}
Breeder	7.25×10^{-5}
Fusion d.t.	7.25×10^{-5}

The wind produces 26 billion TEP/year for, at least, 120 million years, consumes 1% of the copper reserves of the litosphere, offers energy at 35 USD/BOE after 2147.

Summary

The earth is around the year 18000 of its interglacial period (80000 years mean time duration).

Climatic changes happen in this time period due to:

1- Changes of the angle between the earth's axis with the orbit surface of his rotation around the sun
2- Increase of the living animal number (CO2)
3- Decomposition of animal and plants (CO2)
4- Fossil derived energies consumed by the humans (CO2)

From 2, 3, 4 an excess in atmosphere of carbon dioxide and other gases causes atmospheric changes.

Not polluting energy can be used against pollution 4.

The objectives of the planetary wind system (ref. 1)

a- Not polluting energy for planetary consumptions sold at market sustainable and decreasing prices, for time duration extremely long
b- Probability reduction of not sustainable climatic changes
c- World's population grow rate decreasing
d- Orders of magnitude of table 1 resume the planet situation at the year 2081

Table 1. *planet situation 1981-2081 (ref. 4)*

Voice	$CO2 \times 10^9$ ton
Living animals	9645
Decomposition of animal and vegetal world	464
Fossil derived energy consumed	5150
Tot.	15259
Sea absorption	7629
(1) Forest absorption 1	2964
Excess in atmosphere	4685 (+182%)*
(2) Forest absorption 2	3680
Excess in atmosphere	3949 (+154%)*

In table 2 is represented the asynptotic planet scenario where the effects of the fossil derived energy consumed can be considered totally cancelled in the hypotesis that the wind energetic system, discussed in ref. 1, has began to be operative from the year 2022

Table 2. *sustainable development (ref. 1, fig. c)*

Voice	$CO2 \times 10^9$ ton
Living animals	9645
Decomposition of animal and vegetal world	464
Fossil derived energy consumed	-
Tot.	10109
Sea absorption	5054
Forest absorption	4600
Excess in atmosphere	454 (+17.7%)

This asynptotic development is a goal which could be obtained after the year 2160, because of the 100 years of the atmosphere memory for excess of infrared reflecting gases stored.

In preparing table 1 and 2 the following data are been used

Planetary forest vegetation total surface 4 billion hectares

Carbondioxide absorbed 9.2 ton/h.y.

Carbondioxide of the atmosphere, which regulates the earth's surface mean temperature around 15^0 C, 2566 billion ton

Carbondioxide emitted by the human breath 9 ton/y

World's population 11.5 billion

Hydroelectricity 1.7 billion/TEP/y

Wind energy 26 billion/TEP/y

Pro capite energy consumed 2.41 TEP/y

The energy market

The planetary wind system offers energy by 10944 modula, which derive from hydrogen synthetic liquid and gaseous fuels and electricity from turboelectroproducers hydrogen fueled, and from 556 modula hydroelectricity by active hydrostorage of stocastic energy.

The modern comunication system by web grid and smartphones allows each consumer to know energy prices offered by each one of the 11500 modula.

(1) Forest absorption 1 20% deforestation, fire

(2) Forest absorption 2 0% deforestation, fire

The substutive energetic economy

At the year 2081 the planetary population have raised to 11.5 billion from the 7.52 billion of the year 2017.

In the same time the fossil derived energies will go to exhaustion and they will exhibit high market prices, with negative effects on the planetary economy.

The substutive energetic economy will modify the consumption of energy as shown in table 3

Table 3. *energetic substutive economy*

Environment air conditioning – heat pumps	Electricity
Electric induction plates for cooking	Electricity
Environment and street lighting – low consuming lamps	Electricity
Private and public transportation	
Electric city car	Electricity
Electric road car	Electricity
Hydrogen car	Electricity, fuel
Hybrid car	Electricity, fuel
Trucks	Electricity, fuel
Motorcycles	Electricity, fuel
Public road buses	Electricity, fuel
Trains and metro	Electricity
Airplanes	Electricity, fuel
Boats	Electricity, fuel
Hydrogen for industry	Electricity, fuel
Electricity for industry	Electricity, fuel

From table 3 it follows that energy which substitute FDE will be mainly electricity which has to be transformed in to liquid and gaseous fuels, heat and electricity

The equivalent electricity of 26 billion TEP/year, which substitute the fossil derived energy, at the year 2081, is 104000 billion KWhe/year.

This electricity could be produced by the planetary proliferation of

20800000 MWe of thermoelectric breeder (U233, plutonium fueled) or fusion (deuterium, tritium fueled) nuclear convertors, as well as by the proliferation of 90912394 MWep of wind convertors, which produce the equivalent on demand energy to be consumed (ref. 1)

In this frame of considerations, the author has studied a low cost planetary strategy which can regulate the safe equivalent proliferation of wind convertors (ref. 1)

The results of this analysis are 18182394 wind convertors, 5 MWep each, which produce decreasing

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low price on demand energy consumed by a planetary population around 12 billion (ref. 1).

In so doing the sustainable development of table 2 can be satisfied.

In this paper the attention is devolved to the total materials of which is made the wind energetic system, to the consumption intensity of the materials, and to natural decay and programmed recycling processes.

Method

The consumed materials are extracted from the solid lithosphere of the earth's crust.

Than

Solid lithosphere volume 12.56 (216 – 214.3)/3 x 10^{18} mc = 7.117 x 10^{18} mc

Mean lithosphere density 2.7 ton/mc

Solid lithosphere total weigth 7.117 x 2.7 x 10^{18} = 19.22 x 10^{18} ton

Solid lithosphere of the emerged areas 6.41 x 10^{18} ton

The material weigth in the lithosphere (emerged areas) are resumed in table 4, (ref. 2)

Table 4. *material weigth of lithosphere (emerged areas)*

Material	Weigth x 10^{18} ton
Oxygen	2.173
Silicium	1.904
Aluminum	1.36
Iron	0.95
Copper	0.046

The material composition of 5 MWep wind convertor is resumed in table 5

Table 5. *material composition of a 5 MWep wind convertor*

Gondola total weigth 1200 ton
60% steel
40% copper
Blades made of aluminum 452 ton
Stakes made of concrete 3500 ton (40% silicium)
Stakes made of iron 3400 ton
Stakes made of concrete 20%
Stakes made of iron 80%
Total number of stakes 18182394

In table 6 is resumed the material composition of the whole wind power system (90912394 MWep)

Table 6. *material composition of the whole wind power system*

Material	Weigth x 10^9 ton
Silicium	5.09
Iron 1, gondola	13.09
Iron 2, stakes	49.46
Aluminum	7.85
Copper	8.73
Total weigth	84.82

The total weigth of the wind system (ref. 1) does not affect the lithosphere reserves of materials

85 x 10^9/4.26 x 10^{18} = 1.99 x 10^{-8} (ratio between the weigth of the planetary wind system and the weigth of lithosphere's materials)

Reuse

The natural decay (substitution) and the programmed recycling processes are the steps of the perpetual reuse of the wind energetic system as will be demostrated later.

To go on the following hypotesis are made:

1- The stakes of concrete are substituted each 200 years
2- The stakes of iron are recycled each 200 years
3- In each recycling process 1% of the material recycled is lost
4- All the others parts of the wind system are substituted, recycled each 25 years

In table 7 are resumed the materials consumed by the energetic planetary wind park

Table 7. *material consumed by the planetary wind park*

Material	Ton/year x 10^7
Silicium	2.545
Iron 1	0.556
Iron 2	0.247
Aluminum	0.314
Copper	0.349

From table 7 it follows that the wind energetic system can be made of 100% recyclable materials: the stakes of concrete are necessary when the wind convertor is placed in water.

In table 8 is represented the time length necessary to the planetary wind park, 100% operative, to consume 1% of the material extracted from the lithosphere

Table 8. *time length (years) to consume 1% of the lithosphere material reserves*

Material		Years x 10^9	Years x 10^9
Silicium	2.173 x 10^{16}/2.545 x 10^7	0.854	0.776
Iron	0.95 x 10^{16}/0.813 x 10^7	1.168	1.062
Aluminum	1.36 x 10^{16}/0.314 x 10^7	4.33	3.94
Copper	0.046 x 10^{16}/0.349 x 10^7	0.132	0.12

A correction of a factor 1.1, to take in to account of the material reused in the facilities to produce hydroelectricity and hydrogen, which divides the numbers of column 3, is in the last column of the table 8.

Energy reserves

Wind planetary park

$W = 0.12 \times 10^9 y \times 26 \times 10^9 TEP/y = 3.12 \times 10^{18} TEP$

This number may be compared with the equivalent nuclear reserves (ref. 3)

Table 9. *nuclear reserves*

U238	$(12.25 \times 10^{12}$ g x 39 KWe/g)/4000 KWe/TEP = 119.4×10^9 TEP
Breeder (U233, plutonium)	300000 TWyr x 5.2×10^9 BOE/TWyr x 0.145 TEP/BOE = 2.262×10^{14} TEP
Fusion (deuterium, tritium)	2.262×10^{14} TEP

In table 10 is represented the ratio between the nuclear reserves (table 9) and those, W, of the wind planetary park, when 26 x 10^9 TEP/y are produced as liquid and solid fuels, heat and electricity

Table 10. *ratio between nuclear reserves/wind reserves*

Nuclear reserves		
U238	$119.4 \times 10^9/3.12 \times 10^{18}$	3.83×10^{-8}
Breeder (U233, plutonium)	$2.262 \times 10^{14}/3.12 \times 10^{18}$	7.25×10^{-5}
Fusion (deuterium, tritium)		7.25×10^{-5}

Results

The reserves of materials, when 26 x 10^9 TEP/y are produced, are equivalent to 3.12 x 10^{18} TEP, when 1% of the copper reserves of the lithosphere are consumed.

The wind planetary park consumes 1% of the lithosphere copper reserves and produce 26 x 10^9 TEP/y for a time length equal to 120 million years.

Conclusions

The low cost economic strategy allows the proliferation of the planetary wind park of reference 1.

The planetary wind park will produce 26 x 10^9 TEP/y for 120 million years at the price of the energy around 35$/BOE.

In so doing the economy of a planetary society of 12 billion will be sustained at a mean pro capite energy consumed 2.31 TEP/y.

From table 10 the planetary wind park of reference 1 seems the best proposal to sustain a safe world's economy.

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