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Algeria energy production, population growth based on Olduvai Theory

Malika Allali [1*], Mohammed Tamali [2] and Mostefa Rahli [3]

[1] Unité de Recherche en Energies Renouvelables en Milieu Saharien, URER.MS
Centre de Développement des Energies Renouvelables, CDER
B.P. 478, Route de Reggane, 01000 Adrar, Algeria
[2] Department of Electrical Engineering,
Bechar University, 08000, Bechar, Algeria
[3] Department of Electrical Engineering
Université des sciences et de la technologie, Oran, Algeria

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Abstract - *During the last two centuries we have known nothing but exponential growth and in parallel we haveevolved what amounts to an exponential-growth culture, a culture so heavily dependent upon the continuance of exponential growth for its stability that it is incapable of reckoning with problems of no growth. So the Olduvai Theory is based on time-series data of world energy production and population; the data are arrays of discrete numbers year-on-year, not continuous functions of time. Hence the difference calculus must be used, not the infinitesimal calculus. Postulates 1 and 2 require that we distinguish intervals of linear growth from those of exponential growth. Global population has grown to 8.3 billion. Most, though not all, of that growth has been concentrated in South Asia and sub-Saharan Africa, in Algeria will growth to 52 million in 2050 and in 2100 will be 72 million, in Africa and in the same year 2050 will touched 1787 million and in the world will be 9655 million in 2050. The most important measure in the energy balance of Algeria is the total consumption of 42.87 billion kWh per year. Per capita this is an average of 1.065 kWh. Algeria could provide itself completely with self-produced energy. The total production of all energy producing facilities is 54 bn kWh. Thats 126 % of the countries own usage. Despite this Algeria trades its energy with foreign countries. Along with pure consumptions the production, imports and exports play an important role*.

Résumé - *Au cours des deux derniers siècles, nous n'avons connu qu'une croissance exponentielle et, parallèlement, nous avons fait évoluer ce qui équivaut à une culture de croissance exponentielle, une culture si fortement dépendante de la continuité de la croissance exponentielle pour sa stabilité qu'elle est incapable de faire face aux problèmes de croissance nulle. La théorie d'Olduvai est donc basée sur des données chronologiques de la production mondiale d'énergie et de la population ; les données sont des tableaux de nombres discrets d'une année sur l'autre, et non des fonctions continues du temps. C'est pourquoi il faut utiliser le calcul de différence et non le calcul infinitésimal. Les postulats 1 et 2 exigent que l'on distingue les intervalles de croissance linéaire de ceux de croissance exponentielle. La population mondiale est passée à 8,3 milliards d'habitants. La majeure partie, mais pas la totalité, de cette croissance a été concentrée en Asie du Sud et en Afrique subsaharienne, l'Algérie atteindra 52 millions en 2050 et 72 millions en 2100, l'Afrique et la même année 2050 touchera 1787 millions et le monde 9655 millions en 2050. La mesure la plus importante dans le bilan énergétique de l'Algérie est la consommation totale de 42,87 milliards de kWh par an. Par habitant, cela représente une moyenne de 1 065 kWh. L'Algérie pourrait se fournir entièrement en énergie autoproduite. La production totale de l'ensemble des installations de production d'énergie est de 54 milliards de kWh. C'est 126 % de l'usage propre des pays. Malgré cela, l'Algérie échange son énergie avec l'étranger. Outre les consommations pures, la production, les importations et les exportations jouent un rôle important.*

Keywords: Olduvai theory - Energy - Population - Civilization - Growth.

* malikaa450@gmail.com

1. INTRODUCTION

The Olduvai theory is defined by the ratio of world energy production and population.

It states that the life expectancy of Industrial Civilization is less than or equal to 100 years: 1930–2030. After more than a century of strong growth—energy production per capita peaked in 1979. The Olduvai theory explains the 1979 peak and the subsequent decline. Moreover, it says that energy production per capita will fall to its 1930 value by 2030, thus giving Industrial Civilization a lifetime of less than or equal to 100 years. This analysis predicts that the collapse will be strongly correlated with an 'epidemic' of permanent blackouts of high-voltage electric power networks worldwide. [1, 2]

The Olduvai t

heory is a data-based schema that states that the life expectancy of Industrial Civilization is less than or equal 100 years. We shall develop the theory from its early roots in Greek philosophy down to respected scientists in the 20th century. This approach is useful because, although the theory is easy to understand, it is difficult (i.e. distressing) for most people to accept.

The Olduvai theory deals neither with the geology or the paleontology of the Olduvai Gorge. Nor is it prescriptive. Rather, the theory simply attempts to explain the historic world energy production (and use) and population data in terms of overshoot and collapse.

No doubt that the peak and decline of Industrial Civilization, should it occur, will be due to a complex matrix of causes, such as overpopulation, the depletion of nonrenewable resources, environmental damage, pollution, soil erosion, global warming, newly emerging viruses, and resource wars. That said, the Olduvai theory uses a single metric only, as defined by "White's Law." But now it comes with new twist (a will-o'-the-wisp) electricity.

2. PRODUCTION AND DEVELOPMENT

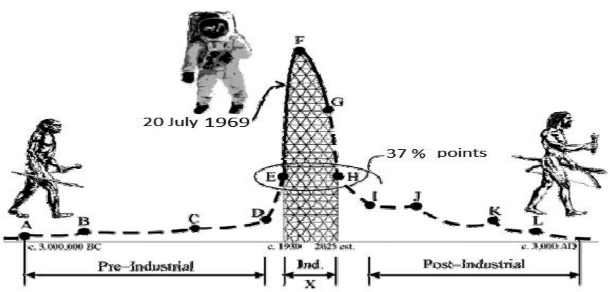

Fig. 1: The Olduvai Theory of Industrial Civilization

a. Pre-Industrial Phase [c. 3,000,000 BC to 1765]

- A = Tool making begins (c. 3,000,000 BC)
- B = Fire use begins (c. 1,000,000 BC)
- C = Neolithic Agricultural Revolution (c. 8,000 BC)
- D = Watt's steam engine, 1765
  - Interval D-E is a transition period.

b. Industrial Phase [1930 to 2025, estimated]

- E = Industrial Civilization is defined to begin in 1930 when the leading-edge value of energyuse per person reached 37% of its peak value.

- F = Peak of Industrial Civilization, c. 1978: confirmed by historic data published by BP, IEA, USCB, UN, etc.
- G = World average energy-use per person continues to fall, 1996
- H = Industrial Civilization is defined to end when energy-use per person shrinks to 37% of its peak value, forecast to occur by 2025. Life-expectancy (X) is estimated to be less than 100 years.
    - Interval H-I is a transition period.

c. Post-Industrial Phase [c. 2100 and beyond]

- J, K, and L = Recurring future attempts at industrialization fail.

3. WHENCE THE NAME 'OLDUVAI'?

Olduvai Gorge is an archaeological site in the eastern Serengeti Plains in northern Tanzania. The gorge is a very steep-sided ravine roughly 30 miles long and 295 ft. deep. Exposed deposits show rich fossil fauna, many hominid remains and items belonging to one of the oldest stone tool technologies, called Olduwan. The objects recovered date from 2,100,000 to 15,000 years ago.

The name of this premier site for studying the Stone Age has been taken to label the theory that industrial civilization will soon collapse and send humankind into precipitous decline. Olduvai Gorge is best known as the site where, in 1959, the discoveries of Mary and Louis Leakey changed paleontology to focus on Africa, rather than Asia, as the region of human origins.

The Oxford Dictionary of Scientists (Oxford University Press, 1999) states: "Leakey's work has not only provided evidence for the greater age of humans but suggests that Africa, and not as was previously thought, Asia, may have been the original center of human evolution."

4. ELECTRICITY GENERATION IN ALGERIA (TWh)

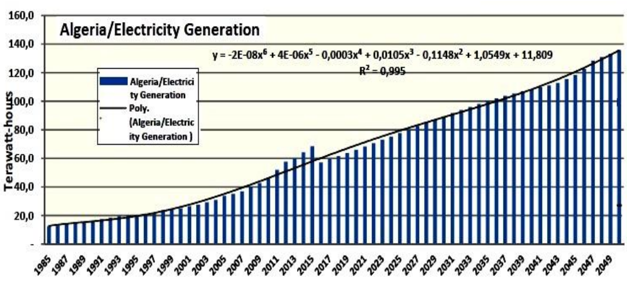

Fig. 2: Electricity generation in Algeria (TWh)

Algeria's electricity generation capacity reached 15.2 gigawatts (GW) at the end of 2013, up from 12.9 GW at the end of 2012 and 11.4 GW at the end of 2011, according to Sonelgaz, the country's public utility in charge of electricity generation and distribution. Sonelgaz has brought additional capacity online to keep up with demand needs.

In the past, Soneglaz has imposed rationing to balance electricity supply and demand. In 2012, the government enforced power cuts that provoked public protest in the summer months. [3]

5. PRODUCTION AND DOMESTIC

CONSUMPTION FORECAST TO 2100 IN ALGERIA [4]

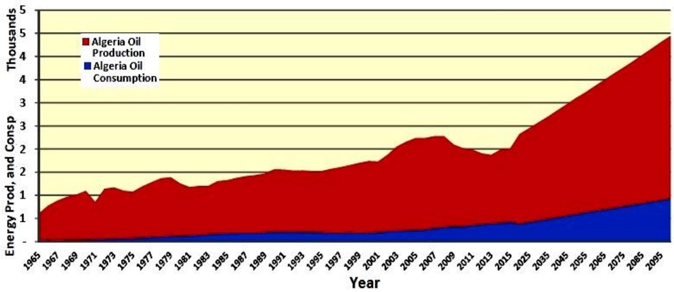

Fig. 3: Energy production and energy consumption in Algeria (**Oil**)

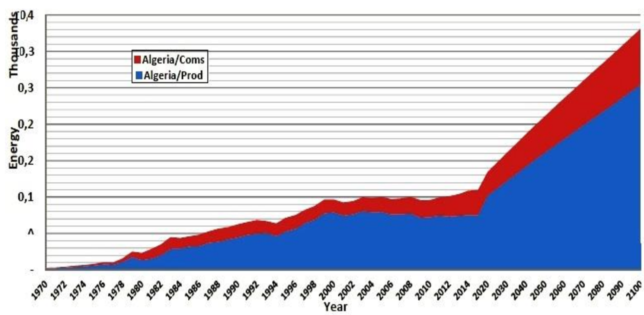

Fig. 4: Energy production and energy consumption in Algeria (**Gas**)

6. ENERGY CONSUMPTION IN ALGERIA

The most important measure in the energy balance of Algeria is the total consumption of 49.00 billion kWh per year. Per capita this is an average of 1,217 kWh, Algeria could provide itself completely with self-produced energy. The total production of all energy producing facilities is 60 bn kWh.

Thats 122% of the countries own usage. Despite this Algeria trades its energy with foreign countries. Along with pure consumptions the production, imports and exports play an important role.

7. ENERGY BALANCE

Table 1: Energy Balance

	Total	Algeria per capita	Compared to Europe per capita
Own consumption	42.87 bn kWh	1.064.73 kWh	5.935.06 kWh
Energy production	53.99 bn kWh	1.340.91 kWh	6.315.27 kWh
Energy imports	936.00 bn kWh	23.73 kWh	568.14 kWh
Energy export	985.00 bn kWh	24.46 kWh	570.70 kWh

By 2030, the demand for electricity will be almost twice as high as current demand, driven by rapid growth in population and income in developing countries, by the continuing increase in the number of electrical devices used in homes and commercial buildings, and by the growth in electrically driven industrial processes.

8. POPULATION GROWTH ESTIMATES

Data: obtained from [5-9].

In my calculation in the introduction, I used the Alger's projection of population of 51.52 Million people by 2050, or an increase of 16.45 Million between 2010 and 2050. (Calculation: Forty years of Population "growth" averaging minus 0.41% per year.

Population growth doesn't look to be very great in figure 5, since it shows annual averages, but we can see from figure 8 (below) what a huge difference it really makes. Population now is almost 45times as large as in 1930.

Since we have historical data, it is possible to calculate an estimate based on regression analysis of the expected population change between 2010 and 2050. If we look at population increases compared to energy growth by period (figure 5), population growth is moderately correlated with energy growth, with an R squared of 0.9788.

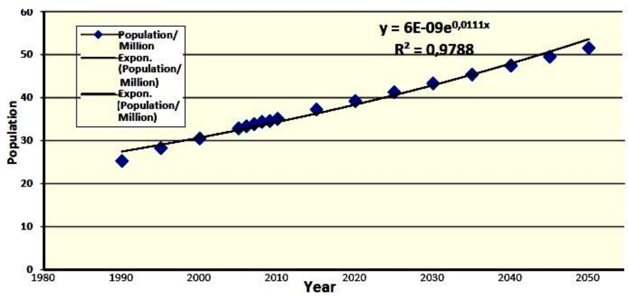

Fig. 5: The growth in population in Algeria. (Forecast to 2100)

9. WORLD ENERGY AND POPULATION FORECAST TO 2100

9.1 Energy demand in the long run

Economic structure and technology are critical determinants of energy demand. At the macro level, each influences energy intensity, where energy intensity is defined as the quantity of energy consumed per unit of economic output. Regarding economic structure, as an economy develops it will generally become more service oriented. To the extent that a unit of service output requires less energy input than a unit of manufacturing output, energy intensity will decline.

Regarding technology, as more energyefficient capital is deployed, the energy requirements for a given level of output decline, thus allowing economic activity to expand without an increase in energy demand. [10]

Empirical evidence supports the notion that energy intensity ultimately growth as economies develops. As an example, figure 6 illustrates the energy intensity for Algeria from 1990 through 2100 plotted against per capita income in the top graph, and against time in the bottom one.

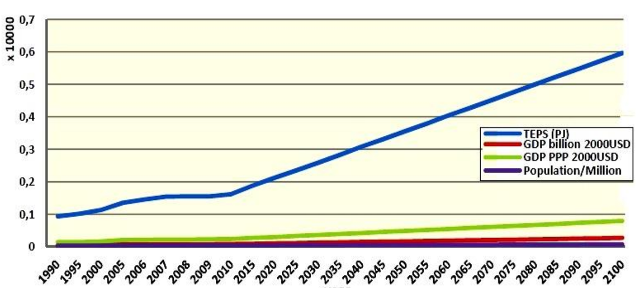

Fig. 6: Trends in energy intensity in Algeria (1990–2100). (Forecast until the 2100)

Also indicated is the industrial share of GDP as an indicator of economic structure over time. Clearly, the trend in energy intensity is upward, indicating more energy consumption per dollar of GDP.

We start by deriving an income-CO_2 relationship based on a structural production function, which captures the idea that income/output depends on energy consumption and therefore CO_2 emissions.

Our structural model enables us to identify and include the relevant economic variables in our empirical regression model. We then use a similar methodology that Xiaobing Zhao (2011) employs. [6]

9.2 Marginal product of electricity [12, 13]

In the case of a function of Cobb-Douglas, the marginal productivity of the energy is equal to the first derivative of the average productivity compared to the energetic intensity.

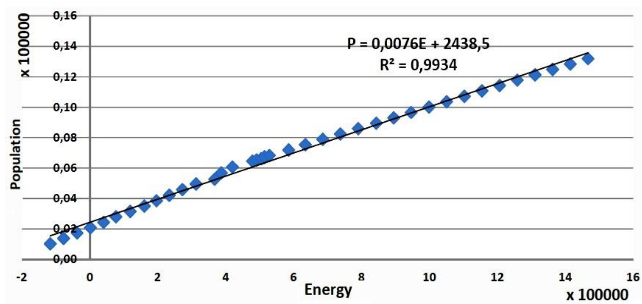

Fig. 7: The relationship of world energy and population input in 1930-2100

Its slope is the marginal product of electricity. It is 0.0076 PJ. And its intercept is Positive. This means that the marginal product of electricity is smaller than the average product of electricity. The average product of electricity is showing a rising trend.

There was a continuous gradual improvement of technical levels and production technology between 2008 and 2020. When electricity consumption was lower than 513 611 PJ (before year 2008), its marginal product of electricity was smaller than its average product of electricity based on the published product volume.

This made the average product of electricity continuously fall when compared with the previous year. When electricity consumption was higher than 513 611 PJ for (POP = 6 688 capita), its marginal product of electricity was smaller than its product of electricity. This made the product of electricity rise to a certain degree.

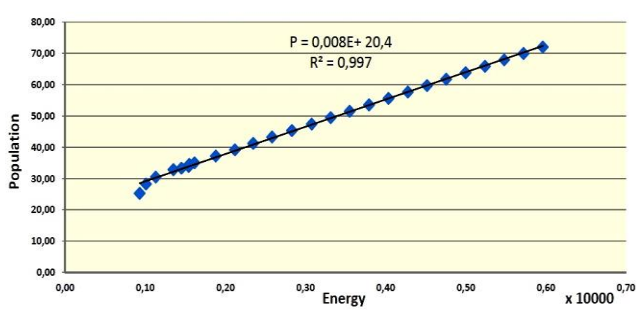

Fig. 8: The relationship of Algeria energy and population- input in 1990-2100

Its slope is the marginal product of electricity. It is 0.008 PJ. And its intercept is Positive. This means that the marginal product of electricity is smaller than the average product of electricity. The average product of electricity is showing a rising trend.

There was a continuous gradual improvement of technical levels and production technology between 2008 and 2020. When electricity consumption was lower than 1552 PJ (before year 2008), its marginal product of electricity was smaller than its average product of electricity based on the published product volume.

This made the average product of electricity continuously fall when compared with the previous year. When electricity consumption was higher than 1552 PJ for (POP = 34.40 capita), its marginal product of electricity was smaller than its product of electricity. This made the product of electricity rise to a certain degree.

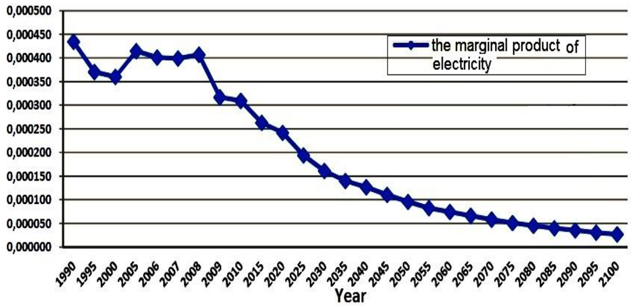

Fig. 9: The marginal product of electricity

The marginal product of electricity will decrease when the production factors; Energy (E) and Population (P) reach a certain amount.

One of the issues in forecasting population using regression analysis is that in the period since 1930, we have examples of negative energy growth for long enough periods that they actually appear in the averages used in this analysis which are before independence (**Table 2**) Even if this model fit very well (which it doesn't), it still wouldn't necessarily be predictive during periods of energy contraction.

Using the regression equation shown in figure 8, population growth would still be positive with an annual contraction of energy of 0.41 % per year, but just barely.

Table 2: The negative energy growth

Year	Energy(PJ)	Year	Energy(PJ)
1930	-1130.43	**1950**	-463.17
1935	-964.45	**1955**	-313.56
1940	-795.74	**1960**	-135.90
1945	-627.46		

10. Energy per Capita

While we use Energy per Capita in this forecast, we can look at historical growth rates in Energy per Capita, compared to growth rates in total energy consumed by society. Here, we get a surprisingly stable relationship:

Figure 7 shows the corresponding regression analysis, with the highest correlation we have seen, an R squared equal to 0.997

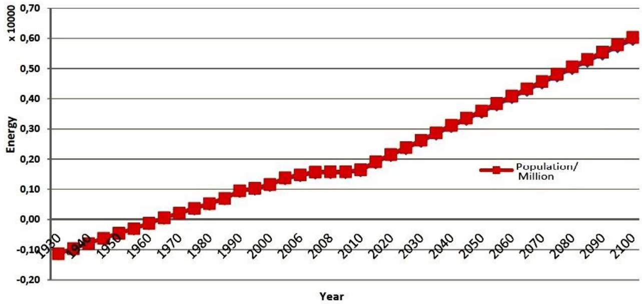

Fig. 10: Comparison of average growth in total energy consumed with the average amount consumed per person, for periods since 2100 in Algeria

1. The duration of industrial civilization [14, 15]

The Olduvai theory states that the life expectancy of industrial civilization is approximately 100 years: circa 1930-2030 but for Algeria we choose all 170 year (1930-2100) for studies and see what happen in there while (e) = Energy/Population.

The duration of industrial civilization is measured by the time in years from when e reaches 30 % of its maximum value to the time when (e) falls back to that value; so after calculation of (e) we have the graph below;

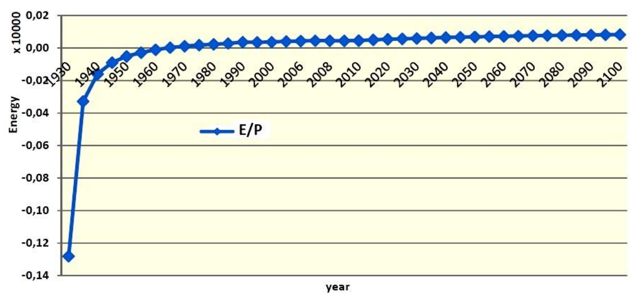

Fig. 11: The sense of Olduvai Theory for Algeria

<u>1930-2100</u>

Stage: (1) 1965(Industrial civilization begins);
(2) 1970 (Very strong growth begins);
(3) 1990 (Growth begins to slow);
(4) 2010(The no-growth “Plateau” begins);
(5) 2015 (The 'Brink' begins);
(6) Circa 2020 (The 'Cliff' begins); and (7) Circa 2025 (Industrial civilization ends).

SUMMARY AND CONCLUSIONS

Many industrialized nations are now growing rapidly and placing ever-greater demands on world resources. Many of those resources come from the presently underdeveloped countries. What will happen when the resource-supplying countries begin to withhold resources because they foresee the day when their own demand will require the available supplies? ... Will the developed nations stand by and let their economies decline while resources still exist in other parts of the world? Will a new era of international conflict grow out of pressures from resource shortage?

So in the "worst cases" forecast from 1930 to 2100 for Algeria, has arrived. These are the key developments:

- Consistent with earlier demographic projections, global population has increased from 25.28 to 39.19 in the year 2020 and it will be 72.06 in the year 2100 in Algeria.
- Automatically with the earlier demographic projection the demand for food has grown by 40 percent, but supplies have not kept up with demand. World grain reserves are empty. The FAO (Food and Agriculture Organization of the United Nations) warns that bad harvests and grain export embargoes are pushing 200 million people to "the brink of starvation." Whatmeans that the evolution in the population gave growth in the consumption of energy whichgave more and more CO2 emission?
- Demand for energy has grown by 45 percent, but supplies in recent years have not kept up, and the resulting scarcity has pushed energy prices to record highs.
- Global demand for water has grown by close to 30 percent. Water conservation measures have helped, but close to four billion people are now livings in an area of high water stress. (Demand for water, Demand for energy so more water =more energy)
- Climate change is more evident, and the concentration of greenhouse gas emissions is dangerously close to the 450 ppm level that could trigger the worst effects of climate change.
- Shortages of food, energy and water are increasing the number of failed states and ratcheting up international tensions.

The global population has grown to 8.3 billion. Most, though not all, of that growth has been concentrated in South Asia and sub-Saharan Africa, and in Algeria will growth to 51 million in 2050, in Africa and in the same year will touched 1787 million and in the world will be 9655 million.

The Death of Industrial Civilization explains how the contemporary ecological crisis within industrial society is caused by the values inherent in unlimited economic growth and competitive materialism. That's shows that the limits-to-growth critique of industrial civilization is the most effective stance against what seems to be a dominant and invincible social order. He prescribes the social changes that must be implemented in order to transform industrial society into a sustainable and more satisfying one.

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