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# The Global Boom of the Infrastructure's Implementation Regarding the Achievement of the Photovoltaic Energy

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ABSTRACT

The power of the electrical energy which was achieved by a single photovoltaic cell it measures between 1 or 2 watts and the architecture of the systems which reflect the chains of photovoltaic cells has the designation of panel. At the global level, the first three countries which head in the achievement of the solar photovoltaic energy are China, the United States and Japan.



## 1. Introduction

This original research follows actually to reflect that the infinity of the solar radiations represents a vector toward a clean electrical energy and that the production of this electricity will gain new areas at global level.

By means of the technology which cans be offered by the photovoltaic cells, we can have in present and future a real clean electrical energy. The conglomerates out of photovoltaic cells transform the solar radiations in electrical energy for to cover the necessary of consumption and for to distribute the excess in the national grid. This convertibility in electricity is without emissions of gas with greenhouse effect.

In the first episode of this itinerary, we can visualize the forecasts of the data regarding the levels of the global photovoltaic energy which will be realized in the period 2025-2030. In the second area of this exploration, we can observe the predictions of the values for the powers's sizes of the global infrastructures which will stock the photovoltaic energy between 2025-2030. In the third segment of this research, we can see the estimations of the data for the powers's sizes of the implemented infrastructures which will stock solar photovoltaic energy in the E.U. in the horizon of time 2025-2030.

For to describe the giant success of the infrastructure's implementation which was reserved for the production of photovoltaic energy and for to realize the predictions from this analysis, we can insert the building of the forecasts through the „Least Squares Method", the real achievement's engine for this research.

The architectural arrangement of the „Least Squares Method" was prepared by Johann Carl Friedrich Gauss who was the number one in the modelling of the regressions's theories.

## 2. The statistical scenario to the values which symbolize the realized levels of global photovoltaic energy in the period 2010-2024

**Table 1. The display of the data for the global photovoltaic energy which was achieved between 2010-2024**

| YEARS | THE GLOBAL PHOTOVOLTAIC ENERGY WHICH WAS REALIZED (terawatts hours) $(\lambda_i)$ |
|---|---|
| 2010 | 33,80 |
| 2011 | 65,60 |
| 2012 | 101,80 |
| 2013 | 137,89 |
| 2014 | 192,60 |
| 2015 | 252,26 |

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| | |
|---|---|
| 2016 | 324,79 |
| 2017 | 437,51 |
| 2018 | 560,03 |
| 2019 | 689,90 |
| 2020 | 835,68 |
| 2021 | 1030,57 |
| 2022 | 1294,48 |
| 2023 | 1600,00 |
| 2024 | 2135,00 |

*Source: „www.Statista.com"*

- if the inflow of data concerning the $\xi$ variable, where $\xi$ = the global photovoltaic energy which was realized, generate a linear equation $\xi_{t_i} = a + b \cdot t_i$, than a and b will be [4]:

**Table 2. The display of the data for the global photovoltaic energy which was realized, if these reflect a linear equation**

| YEARS | THE GLOBAL PHOTOVOLTAIC ENERGY WHICH WAS REALIZED (terawatts hours) $(\xi_i)$ | LINEAR TREND | | | | |
|---|---|---|---|---|---|---|
| | | $t_i$ | $t_i^2$ | $t_i\xi_i$ | $\xi_{t_i} = a + bt_i$ | $\lvert\xi_i - \xi_{t_i}\rvert$ |
| 2010 | 33,80 | -7 | 49 | -236,60 | -266,0896668 | 299,89 |
| 2011 | 65,60 | -6 | 36 | -393,60 | -135,7729525 | 201,37 |
| 2012 | 101,80 | -5 | 25 | -509,00 | -5,456238200 | 107,26 |
| 2013 | 137,89 | -4 | 16 | -551,56 | +124,8604761 | 13,03 |
| 2014 | 192,60 | -3 | 9 | -577,80 | +255,1771904 | 62,58 |
| 2015 | 252,26 | -2 | 4 | -504.52 | +385,4939047 | 133,23 |
| 2016 | 324,79 | -1 | 1 | -324,79 | +515,8106190 | 191,02 |
| 2017 | 437,51 | 0 | 0 | 0 | +646,1273333 | 208,62 |
| 2018 | 560,03 | +1 | 1 | +560,03 | +776,4440476 | 216,41 |
| 2019 | 689,90 | +2 | 4 | +1379,80 | +906,7607619 | 216,86 |
| 2020 | 835,68 | +3 | 9 | +2507,04 | +1037,077476 | 201,40 |
| 2021 | 1030,57 | +4 | 16 | +4122,28 | +1167,394191 | 136,82 |
| 2022 | 1294,48 | +5 | 25 | +6472,40 | +1297,710905 | 3,23 |
| 2023 | 1600,00 | +6 | 36 | +9600,00 | +1428,027619 | 171,97 |
| 2024 | 2135,00 | +7 | 49 | +14945,00 | +1558,344333 | 576,66 |
| TOTAL | 9691,91 | 0 | 280 | 36488,68 | 9691,91 | 2740,35 |

$$a = \frac{\sum_{i=1}^{n}\xi_i \sum_{i=1}^{n} t_i^2 - \sum_{i=1}^{n}\xi_i t_i \sum_{i=1}^{n} t_i}{n\sum_{i=1}^{n} t_i^2 - \left(\sum_{i=1}^{n} t_i\right)^2} = \frac{9691{,}91 \cdot 280}{15 \cdot 280} = 646{,}1273333 \quad b = \frac{n\sum_{i=1}^{n}\xi_i t_i - \sum_{i=1}^{n} t_i \sum_{i=1}^{n}\xi_i}{n\sum_{i=1}^{n} t_i^2 - \left(\sum_{i=1}^{n} t_i\right)^2} = \frac{15 \cdot 36488{,}68}{15 \cdot 280} = 130{,}3167143$$

$$v_I = \left[\frac{\sum_{i=1}^{m}\left|\xi_i - \xi_{t_i}^I\right|}{n} : \frac{\sum_{i=1}^{m}\xi_i}{n}\right] \cdot 100 = \frac{\sum_{i=1}^{m}\left|\xi_i - \xi_{t_i}^I\right|}{\sum_{i=1}^{m}\xi_i} \cdot 100 = \frac{2740{,}35}{9691{,}91} \cdot 100 = 28{,}27\%$$

- if the inflow of data concerning the $\xi$ variable, where $\xi$ = the global photovoltaic energy which was realized, generate a quadratic equation $\xi_{t_i} = a + b \cdot t_i + ct_i^2$, than a and b will be [4]:

**Table 3. The display of the data for the global photovoltaic which was realized, if these reflect a quadratic equation**

| YEARS | THE GLOBAL PHOTOVOLTAIC ENERGY WHICH WAS REALIZED (terawatts hours) ($\xi_i$) | PARABOLIC TREND | | | | | |
|---|---|---|---|---|---|---|---|
| | | $t_i$ | $t_i^2$ | $t_i^4$ | $t_i^2\xi_i$ | $\xi_{t_i} = a + bt_i + ct_i^2$ | $\lvert\xi_i - \xi_{t_i}\rvert$ |
| 2010 | 33,80 | -7 | 49 | 2401 | 1656,20 | 122,3477352 | 88,55 |
| 2011 | 65,60 | -6 | 36 | 1296 | 2361,60 | 86,19127734 | 20,59 |
| 2012 | 101,80 | -5 | 25 | 625 | 2545,00 | 75,64607660 | 26,15 |
| 2013 | 137,89 | -4 | 16 | 256 | 2206,24 | 90,71213314 | 47,18 |
| 2014 | 192,60 | -3 | 9 | 81 | 1733,40 | 131,3894470 | 61,21 |
| 2015 | 252,26 | -2 | 4 | 16 | 1009,04 | 197,6780181 | 54,58 |
| 2016 | 324,79 | -1 | 1 | 1 | 324,79 | 289,5778464 | 35,21 |
| 2017 | 437,51 | 0 | 0 | 0 | 0 | 407,0889321 | 30,42 |
| 2018 | 560,03 | +1 | 1 | 1 | 560,03 | 550,2112750 | 9,82 |
| 2019 | 689,90 | +2 | 4 | 16 | 2759,60 | 718,9448753 | 29,04 |
| 2020 | 835,68 | +3 | 9 | 81 | 7521,12 | 913,2897328 | 77,61 |
| 2021 | 1030,57 | +4 | 16 | 256 | 16489,12 | 1133,245848 | 102,68 |
| 2022 | 1294,48 | +5 | 25 | 625 | 32362,00 | 1378,813220 | 84,33 |
| 2023 | 1600,00 | +6 | 36 | 1296 | 57600,00 | 1649,991849 | 49,99 |
| 2024 | 2135,00 | +7 | 49 | 2401 | 104615,00 | 1946,781736 | 188,22 |
| TOTAL | 9691,91 | 0 | 280 | 9352 | 233743,14 | | 905,58 |

$$a = \frac{\sum_{i=1}^{n} t_i^4 \sum_{i=1}^{n} \xi_i - \sum_{i=1}^{n} t_i^2 \sum_{i=1}^{n} t_i^2 \cdot \xi_i}{n\sum_{i=1}^{n} t_i{}^4 - \left(\sum_{i=1}^{n} t_i^2\right)^2} = \frac{9352 \cdot 9691{,}91 - 280 \cdot 233743{,}14}{15 \cdot 9352 - 280^2} = 407{,}0889321$$

$$b = \frac{\sum_{i=1}^{n} \xi_i t_i}{\sum_{i=1}^{n} t_i{}^2} = \frac{36488{,}68}{280} = 130{,}3167143$$

$$c = \frac{n \cdot \sum_{i=1}^{n} t_i^2 \cdot \xi_i - \sum_{i=1}^{n} t_i^2 \cdot \sum_{i=1}^{n} \xi_i}{n\sum_{i=1}^{n} t_i{}^4 - \left(\sum_{i=1}^{n} t_i^2\right)^2} = \frac{15 \cdot 233743{,}14 - 280 \cdot 9691{,}91}{15 \cdot 9352 - 280^2} = 12{,}80562864$$

$$v_{II} = \left[\frac{\sum_{i=1}^{m} \left|\xi_i - \xi_{t_i}^{II}\right|}{n} : \frac{\sum_{i=1}^{m} \xi_i}{n}\right] \cdot 100 = \frac{\sum_{i=1}^{m} \left|\xi_i - \xi_{t_i}^{II}\right|}{\sum_{i=1}^{m} \xi_i} \cdot 100 = \frac{905{,}58}{9691{,}91} \cdot 100 = 9{,}34\%$$

- if the inflow of data concerning the $\xi$ variable, where $\xi$ = the global photovoltaic energy which was realized, generate an exponential equation $\xi_{t_i} = ab^{t_i}$, than a and b will be [4]:

$$\lg a = \frac{\begin{vmatrix} \sum_{i=1}^{n} \lg \xi_i & \sum_{i=1}^{n} t_i \\ \sum_{i=1}^{n} t_i \lg \xi_i & \sum_{i=1}^{n} t_i{}^2 \end{vmatrix}}{\begin{vmatrix} n & \sum_{i=1}^{n} t_i \\ \sum_{i=1}^{n} t_i & \sum_{i=1}^{n} t_i^2 \end{vmatrix}} = \frac{\sum_{i=1}^{n} \lg \xi_i \sum_{i=1}^{n} t_i^2 - \sum_{i=1}^{n} t_i \lg \xi_i \sum_{i=1}^{n} t_i}{n\sum_{i=1}^{n} t_i^2 - \left(\sum_{i=1}^{n} t_i\right)^2} \qquad \lg b = \frac{\begin{vmatrix} n & \sum_{i=1}^{n} \lg \xi_i \\ \sum_{i=1}^{n} t_i & \sum_{i=1}^{n} t_i \lg \xi_i \end{vmatrix}}{\begin{vmatrix} n & \sum_{i=1}^{n} t_i \\ \sum_{i=1}^{n} t_i & \sum_{i=1}^{n} t_i^2 \end{vmatrix}} = \frac{n \cdot \sum_{i=1}^{n} t_i \lg \xi_i - \sum_{i=1}^{n} \lg \xi_i \sum_{i=1}^{n} t_i}{n\sum_{i=1}^{n} t_i{}^2 - \left(\sum_{i=1}^{n} t_i\right)^2}$$

**Table 4. The display of the data for the global photovoltaic energy which was realized, if these reflect an exponential equation**

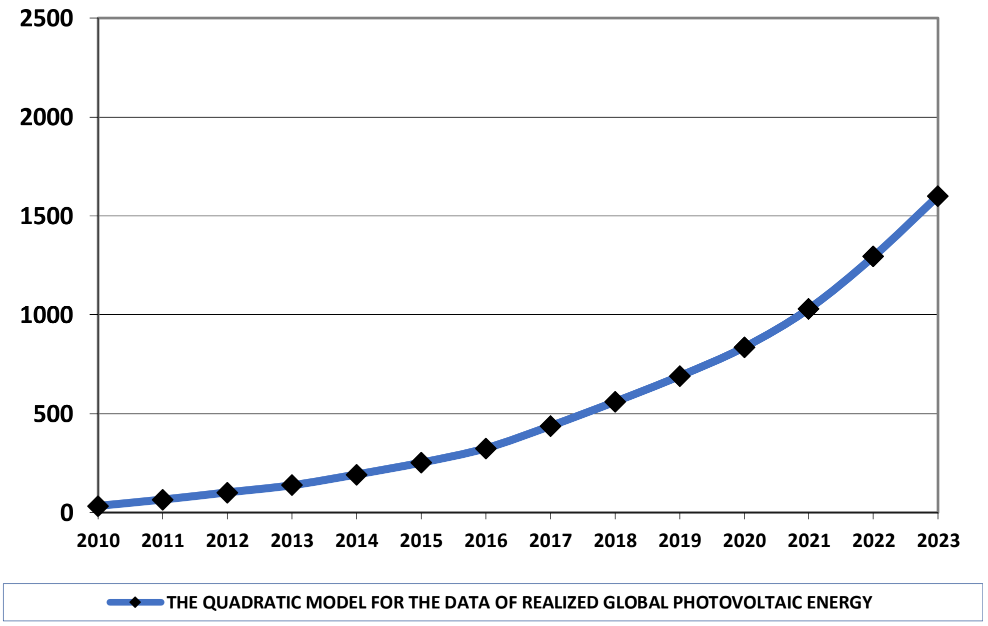
| YEARS | THE GLOBAL PHOTOVOLTAIC ENERGY WHICH WAS REALIZED (terawatts hours) $(\xi_i)$ | EXPONENTIAL TREND | | | | | |
|---|---|---|---|---|---|---|---|
| | | $t_i$ | $\lg \xi_i$ | $t_i \lg \xi_i$ | $\lg \xi_{t_i} = \lg a + t_i \lg b$ | $\xi_{t_i} = ab^{t_i}$ | $\lvert \xi_i - \xi_{t_i} \rvert$ |
| 2010 | 33,80 | -7 | 1,528916700 | -10,70241690 | 1,742531210 | 55,27531294 | 21,47 |
| 2011 | 65,60 | -6 | 1,816903839 | -10,90142304 | 1,860264128 | 72,48766795 | 6,89 |
| 2012 | 101,80 | -5 | 2,007747778 | -10,03873889 | 1,977997046 | 95.05983278 | 6,74 |
| 2013 | 137,89 | -4 | 2,139532772 | -8,558131086 | 2,095729964 | 124,6608156 | 13,23 |
| 2014 | 192,60 | -3 | 2,284656283 | -6,853968848 | 2,213462882 | 163,4793424 | 29,12 |
| 2015 | 252,26 | -2 | 2,401848391 | -4,803696783 | 2,331195800 | 214,3856933 | 37.87 |
| 2016 | 324,79 | -1 | 2,511602649 | -2,511602649 | 2,684394554 | 483,4978575 | 158,71 |
| 2017 | 437,51 | 0 | 2,640987984 | 0 | 2,566661636 | 368,6902357 | 68,82 |
| 2018 | 560,03 | +1 | 2,748211292 | +2,748211292 | 2,684394554 | 483,4978575 | 76,53 |
| 2019 | 689,90 | +2 | 2,838786145 | +5,775722900 | 2,802127472 | 634,0557889 | 55,84 |
| 2020 | 835,68 | +3 | 2,922040008 | +8,766120025 | 2,919860390 | 831,4964320 | 4,18 |
| 2021 | 1030,57 | +4 | 3,013077496 | +12,05230998 | 3,037593308 | 1090,418743 | 59,85 |
| 2022 | 1294,48 | +5 | 3,112095345 | +15,56047672 | 3,155326226 | 1429,967694 | 135,49 |
| 2023 | 1600,00 | +6 | 3,204119983 | +19,22471990 | 3,273059144 | 1875,249870 | 275,25 |
| 2024 | 2135,00 | +7 | 3,329397879 | +23,30578516 | 3,390792062 | 2459,189875 | 324,19 |
| TOTAL | 9691,91 | 0 | 38,49992455 | 32,96521717 | | | 1274,18 |

$$\lg a = \frac{38{,}49992455 \cdot 280}{15 \cdot 280} = 2{,}566661636 \quad \lg b = \frac{15 \cdot 32{,}96521717}{15 \cdot 280} = 0{,}117732918$$

$$v_{\exp} = \left[ \frac{\sum_{i=1}^{n} \left| \xi_i - \xi_{t_i}^{\exp} \right|}{n} : \frac{\sum_{i=1}^{n} \xi_i}{n} \right] \cdot 100 = \frac{\sum_{i=1}^{n} \left| \xi_i - \xi_{t_i}^{\exp} \right|}{\sum_{i=1}^{n} \xi_i} \cdot 100 = \frac{1274{,}18}{9691{,}91} \cdot 100 = 13{,}15\%$$

$$v_{II} = 9{,}34\% < v_{\exp} = 13{,}15\% < v_I = 28{,}27\%$$

The values regarding the global production of photovoltaic energy which was realized depict a quadratic equation $\xi_{t_i} = a + b \cdot t_i + c t_i^2$




**Graph 1. The depiction of the quadratic pattern for the global photovoltaic energy which was achieved between 2010-2023**

$$\xi_{2025}^{GLOBAL\_SOLAR\_PHOTOVOLATIC\_ENERGY} = 407{,}0889321 + 130{,}3167143 \cdot 8 + 12{,}80562864 \cdot 8^2 = 2269{,}18 terawatts\_hours$$
$$\xi_{2026}^{GLOBAL\_SOLAR\_PHOTOVOLATIC\_ENERGY} = 407{,}0889321 + 130{,}3167143 \cdot 9 + 12{,}80562864 \cdot 9^2 = 2617{,}19 terawatts\_hours$$
$$\xi_{2027}^{GLOBAL\_SOLAR\_PHOTOVOLATIC\_ENERGY} = 407{,}0889321 + 130{,}3167143 \cdot 10 + 12{,}80562864 \cdot 10^2 = 2990{,}08 terawatts\_hours$$
$$\xi_{2028}^{GLOBAL\_SOLAR\_PHOTOVOLATIC\_ENERGY} = 407{,}0889321 + 130{,}3167143 \cdot 11 + 12{,}80562864 \cdot 11^2 = 3390{,}05 terawatts\_hours$$
$$\xi_{2029}^{GLOBAL\_SOLAR\_PHOTOVOLATIC\_ENERGY} = 407{,}0889321 + 130{,}3167143 \cdot 12 + 12{,}80562864 \cdot 12^2 = 3814{,}90 terawatts\_hours$$
$$\xi_{2030}^{GLOBAL\_SOLAR\_PHOTOVOLATIC\_ENERGY} = 407{,}0889321 + 130{,}3167143 \cdot 13 + 12{,}80562864 \cdot 13^2 = 4265{,}36 terawatts\_hours$$

## 3. The statistical scenario on the values which symbolize the powers's sizes for the implemented infrastructures which stocked the global photovoltaic energy between 2020-2024

**Table 5. The display of the data for the powers of the implemented infrastructures regarding the global photovoltaic energy which was stocked between 2014-2024**

| YEARS | THE POWERS'S SIZES FOR THE IMPLEMENTED INFRASTRUCTURES WHICH STOCKED THE GLOBAL PHOTOVOLTAIC ENERGY (terawatts) $(\lambda_i)$ |
|---|---|
| 2014 | 0,178 |
| 2015 | 0,229 |
| 2016 | 0,306 |
| 2017 | 0,404 |
| 2018 | 0,509 |
| 2019 | 0,634 |
| 2020 | 0,772 |
| 2021 | 0,940 |
| 2022 | 1,177 |
| 2023 | 1,624 |
| 2024 | 1,865 |

*Source: „www.Statista,com"*

✧ if the inflow of data regarding the $\lambda$ variable, where $\lambda$ = the powers's sizes for the implemented infrastructures which stocked the global photovoltaic energy, generate a linear equation $\lambda_{t_i} = a + b \cdot t_i$, than a and b will be [4]:

**Table 6. The display of the data regarding the powers's sizes for the implemented infrastructures which stocked the global photovoltaic energy, if these reflect a linear equation**

| YEARS | THE POWERS'S SIZES FOR THE IMPLEMENTED INFRASTRUCTURES WHICH STOCKED THE GLOBAL PHOTOVOLTAIC ENERGY (terawatts) $(\lambda_i)$ | LINEAR TREND | | | | |
|---|---|---|---|---|---|---|
| | | $t_i$ | $t_i^2$ | $t_i\lambda_i$ | $\lambda_{t_i} = a + bt_i$ | $\lvert\lambda_i - \lambda_{t_i}\rvert$ |
| 2014 | 0,178 | -5 | 25 | -0,890 | -0,031227273 | 0,209 |
| 2015 | 0,229 | -4 | 16 | -0,916 | 0,132072727 | 0,097 |
| 2016 | 0,306 | -3 | 9 | -0,918 | 0,295372727 | 0,011 |
| 2017 | 0,404 | -2 | 4 | -0,808 | 0,458672727 | 0,055 |
| 2018 | 0,509 | -1 | 1 | -0,509 | 0,621972727 | 0,113 |
| 2019 | 0,634 | 0 | 0 | 0 | 0,785272727 | 0,151 |
| 2020 | 0,772 | +1 | 1 | 0,772 | 0,948572727 | 0,177 |
| 2021 | 0,940 | +2 | 4 | 1,880 | 1,111872727 | 0,172 |
| 2022 | 1,177 | +3 | 9 | 3,531 | 1,275172727 | 0,098 |
| 2023 | 1,624 | +4 | 16 | 6,496 | 1,438472727 | 0,186 |
| 2024 | 1,865 | +5 | 25 | 9,325 | 1,601772727 | 0,263 |
| TOTAL | 8,638 | 0 | 110 | 17,963 | | 1,532 |

$$a = \frac{\sum_{i=1}^{n}\lambda_i \sum_{i=1}^{n} t_i^2 - \sum_{i=1}^{n}\lambda_i t_i \sum_{i=1}^{n} t_i}{n\sum_{i=1}^{n} t_i^2 - \left(\sum_{i=1}^{n} t_i\right)^2} = \frac{8{,}638 \cdot 110}{11 \cdot 110} = 0{,}785272727$$

$$b=\frac{n\sum_{i=1}^{n}\lambda_i t_i-\sum_{i=1}^{n}t_i\sum_{i=1}^{n}\lambda_i}{n\sum_{i=1}^{n}t_i^{\,2}-\left(\sum_{i=1}^{n}t_i\right)^2}=\frac{11\cdot 17{,}963}{11\cdot 110}=0{,}1633$$

$$v_I=\left[\frac{\sum_{i=1}^{n}\left|\lambda_i-\lambda_{t_i}^{I}\right|}{n}:\frac{\sum_{i=1}^{n}\omega_i}{n}\right]\cdot 100=\frac{\sum_{i=1}^{n}\left|\lambda_i-\lambda_{t_i}^{I}\right|}{\sum_{i=1}^{n}\lambda_i}\cdot 100=\frac{1{,}532}{8{,}638}\cdot 100=17{,}74\%$$

- if the inflow of data regarding the $\lambda$ variable, where $\lambda$ = the powers's sizes for the implemented infrastructures which stocked the global photovoltaic energy, generate a quadratic equation $\lambda_{t_i}=a+b\cdot t_i+ct_i^2$, than a and b will be [4]:

**Table 7. The display of the data regarding the powers's sizes for the implemented infrastructures which stocked the global photovoltaic energy, if these reflect a quadratic equation**

| YEARS | THE POWERS'S SIZES FOR THE IMPLEMENTED INFRASTRUCTURES WHICH STOCKED THE GLOBAL PHOTOVOLTAIC ENERGY (terawatts) $(\lambda_i)$ | PARABOLIC TREND | | | | | |
|---|---|---|---|---|---|---|---|
| | | $t_i$ | $t_i^2$ | $t_i^4$ | $t_i^2\lambda_i$ | $\lambda_{t_i}=a+bt_i+ct_i^2$ | $\left\lvert\lambda_i-\lambda_{t_i}\right\rvert$ |
| 2014 | 0,178 | -5 | 25 | 625 | 4,450 | -0,234706293 | 0,413 |
| 2015 | 0,229 | -4 | 16 | 256 | 3,664 | 0,050681119 | 0,178 |
| 2016 | 0,306 | -3 | 9 | 81 | 2,754 | 0,308937995 | 0,003 |
| 2017 | 0,404 | -2 | 4 | 16 | 1,616 | 0,540064335 | 0,136 |
| 2018 | 0,509 | -1 | 1 | 1 | 0,509 | 0,744060139 | 0,235 |
| 2019 | 0,634 | 0 | 0 | 0 | 0 | 0,920925407 | 0,287 |
| 2020 | 0,772 | +1 | 1 | 1 | 0,772 | 1,070660139 | 0,299 |
| 2021 | 0,940 | +2 | 4 | 16 | 3,760 | 1,193264335 | 0,253 |
| 2022 | 1,177 | +3 | 9 | 81 | 10,593 | 1,288737995 | 0,112 |
| 2023 | 1,624 | +4 | 16 | 256 | 25,984 | 1,357081119 | 0,267 |
| 2024 | 1,865 | +5 | 25 | 625 | 46,625 | 1,398293707 | 0,467 |
| TOTAL | 8,638 | 0 | 110 | 1958 | 74,741 | 8,638 | 2,650 |

$$a=\frac{\sum_{i=1}^{n}t_i^4\sum_{i=1}^{n}\lambda_i-\sum_{i=1}^{n}t_i^2\sum_{i=1}^{n}t_i^2\cdot\lambda_i}{n\sum_{i=1}^{n}t_i^{\,4}-\left(\sum_{i=1}^{n}t_i^2\right)^2}=\frac{1958\cdot 8{,}638-110\cdot 74{,}741}{11\cdot 1958-110^2}=0{,}920925407$$

$$b=\frac{\sum_{i=1}^{n}\lambda_i t_i}{\sum_{i=1}^{n}t_i^{\,2}}=\frac{17{,}963}{110}=0{,}1633$$

$$c=\frac{n\cdot\sum_{i=1}^{n}t_i^2\cdot\lambda_i-\sum_{i=1}^{n}t_i^2\cdot\sum_{i=1}^{n}\lambda_i}{n\sum_{i=1}^{n}t_i^{\,4}-\left(\sum_{i=1}^{n}t_i^2\right)^2}=\frac{11\cdot 74{,}741-110\cdot 8{,}638}{11\cdot 1958-110^2}=-0{,}013565268$$

$$v_{II}=\left[\frac{\sum_{i=1}^{n}\left|\lambda_i-\lambda_{t_i}^{II}\right|}{n}:\frac{\sum_{i=1}^{n}\lambda_i}{n}\right]\cdot 100=\frac{\sum_{i=1}^{n}\left|\lambda_i-\lambda_{t_i}^{II}\right|}{\sum_{i=1}^{n}\lambda_i}\cdot 100=\frac{2{,}650}{8{,}638}\cdot 100=30{,}68\%$$

- if the inflow of data regarding the $\lambda$ variable, where $\lambda$ = the powers's sizes for the implemented infrastructures which stocked the global photovoltaic energy, generate an exponential equation $\lambda_{t_i}=ab^{t_i}$, than a and b will be [4]:

**Table 8. The display of the data regarding the powers's sizes for the implemented infrastructures which stocked the global photovoltaic energy, if these an exponential equation**

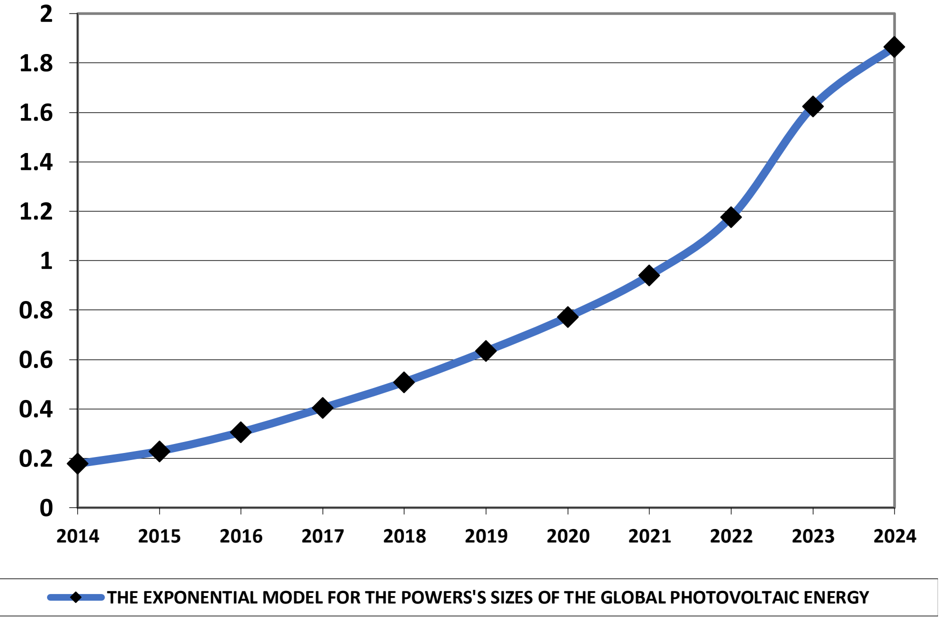
| YEARS | THE POWERS'S SIZES FOR THE IMPLEMENTED INFRASTRUCTURES WHICH STOCKED THE GLOBAL PHOTOVOLTAIC ENERGY (terawatts) $(\lambda_i)$ | EXPONENTIAL TREND | | | | | |
|---|---|---|---|---|---|---|---|
| | | $t_i$ | $\lg \lambda_i$ | $t_i \lg \lambda_i$ | $\lg \lambda_{t_i} = \lg a + t_i \lg b$ | $\lambda_{t_i} = ab^{t_i}$ | $\lvert \lambda_i - \lambda_{t_i} \rvert$ |
| 2014 | 0,178 | -5 | -0,749579997 | 3,747899988 | -0,723906832 | 0,188839641 | 0,011 |
| 2015 | 0,229 | -4 | -0,640164517 | 2,560658071 | -0,622326342 | 0,238601768 | 0,010 |
| 2016 | 0,306 | -3 | -0,514278573 | 1,542835721 | -0,088737088 | 0,815197636 | 0,509 |
| 2017 | 0,404 | -2 | -0,393618634 | 0,787237269 | -0,419165362 | 0,380920756 | 0,023 |
| 2018 | 0,509 | -1 | -0,293282217 | 0,293282217 | -0,317584872 | 0,481299186 | 0,028 |
| 2019 | 0,634 | 0 | -0,197910742 | 0 | -0,216004382 | 0,608128865 | 0,026 |
| 2020 | 0,772 | +1 | -0,112382699 | -0,112382699 | -0,114423892 | 0,768380098 | 0,004 |
| 2021 | 0,940 | +2 | -0,026872146 | -0,053744292 | -0,012843402 | 0,970859977 | 0,031 |
| 2022 | 1,177 | +3 | +0,070776462 | +0,212329388 | +0,088737088 | 1,226696392 | 0,050 |
| 2023 | 1,624 | +4 | +0,210586024 | +0,842344099 | +0,190317578 | 1,549949606 | 0,074 |
| 2024 | 1,865 | +5 | +0,270678836 | +1,353394181 | +0,291898068 | 1,958384973 | 0,093 |
| TOTAL | 8,638 | 0 | -2,376048206 | 11,17385394 | | | 0,859 |

$$\lg a = \frac{\sum_{i=1}^{n} \lg \lambda_i \sum_{i=1}^{n} t_i^2 - \sum_{i=1}^{n} t_i \lg \lambda_i \sum_{i=1}^{n} t_i}{n\sum_{i=1}^{n} t_i^2 - \left(\sum_{i=1}^{n} t_i\right)^2} = \frac{(-2,376048206)\cdot 110}{11\cdot 110} = -0,216004382$$

$$\lg b = \frac{n\cdot \sum_{i=1}^{n} t_i \lg \lambda_i - \sum_{i=1}^{n} \lg \lambda_i \sum_{i=1}^{n} t_i}{n\sum_{i=1}^{n} t_i^2 - \left(\sum_{i=1}^{n} t_i\right)^2} = \frac{11\cdot 11{,}17385394}{11\cdot 110} = 0,10158049$$

$$v_{\exp} = \left[\frac{\sum_{i=1}^{n} \left|\lambda_i - \lambda_{t_i}^{\exp}\right|}{n} : \frac{\sum_{i=1}^{n} \lambda_i}{n}\right]\cdot 100 = \frac{\sum_{i=1}^{n} \left|\lambda_i - \lambda_{t_i}^{\exp}\right|}{\sum_{i=1}^{n} \lambda_i}\cdot 100 = \frac{0,859}{8,638}\cdot 100 = 9,94\%$$

$$v_{\exp} = 9,94\% < v_I = 17,74\% < v_{II} = 30,68\%$$




**Graph 2. The depiction of the exponential pattern regarding the powers's sizes for the implemented infrastructures which stocked the global photovoltaic between 2014-2024**

The values concerning the powers's sizes for the implemented infrastructures which stocked the global photovoltaic energy depict an exponential equation $\lambda_{t_i} = ab^{t_i}$

$$\lambda_{2025}^{GLOBAL\_SOLAR\_PHOTOVOLTAIC\_CAPACITY} = 0{,}608128865 \cdot 1{,}263515256^{6} = 2{,}47\_terawatts$$
$$\lambda_{2026}^{GLOBAL\_SOLAR\_PHOTOVOLTAIC\_CAPACITY} = 0{,}608128865 \cdot 1{,}263515256^{7} = 3{,}13\_terawatts$$
$$\lambda_{2027}^{GLOBAL\_SOLAR\_PHOTOVOLTAIC\_CAPACITY} = 0{,}608128865 \cdot 1{,}263515256^{8} = 3{,}95\_terawatts$$
$$\lambda_{2028}^{GLOBAL\_SOLAR\_PHOTOVOLTAIC\_CAPACITY} = 0{,}608128865 \cdot 1{,}263515256^{9} = 4{,}99\_terawatts$$
$$\lambda_{2029}^{GLOBAL\_SOLAR\_PHOTOVOLTAIC\_CAPACITY} = 0{,}608128865 \cdot 1{,}263515256^{10} = 6{,}31\_terawatts$$
$$\lambda_{2030}^{GLOBAL\_SOLAR\_PHOTOVOLTAIC\_CAPACITY} = 0{,}608128865 \cdot 1{,}263515256^{11} = 7{,}97\_terawatts$$

## 4. The statistical scenario on the values which symbolize the powers's sizes of the implemented infrastructures which stocked the photovoltaic energy in the E.U., between 2021-2024

**Table 9. The display of the data for the powers's sizes of the implemented infrastructures which stocked the photovoltaic energy in the E.U., between 2021-2024**

| YEARS | THE POWERS'S SIZES FOR THE IMPLEMENTED INFRASTRUCTURES WHICH STOCKED THE PHOTOVOLTAIC ENERGY IN THE EUROPEAN UNION (gigawatts) $(\lambda_i)$ |
|---|---|
| 2021 | 164 |
| 2022 | 200 |
| 2023 | 269 |
| 2024 | 333 |

*Source: „www.Solarpowereurope.org"*

✧ if the inflow of data concerning the $\omega$ variable, where $\omega$ = the powers's sizes of the implemented infrastructures which stocked the photovoltaic energy in the E.U., generate a linear equation $\omega_{t_i} = a + b \cdot t_i$, than a and b will be [4]:

**Table 10. The display of the data regarding the powers's sizes for the implemented infrastructures which stocked the photovoltaic energy in the E.U., if these reflect a linear equation**

| YEARS | THE POWERS'S SIZES FOR THE IMPLEMENTED INFRASTRUCTURES WHICH STOCKED THE PHOTOVOLTAIC ENERGY IN THE E.U. (gigawatts) $(\omega_i)$ | LINEAR TREND | | | | |
|---|---|---|---|---|---|---|
| | | $t_i$ | $t_i^2$ | $t_i\omega_i$ | $\omega_{t_i} = a + bt_i$ | $\lvert\omega_i - \omega_{t_i}\rvert$ |
| 2021 | 164 | -2 | 4 | -328 | 160,1 | 3,9 |
| 2022 | 200 | -1 | 1 | -200 | 200,8 | 0,8 |
| 2023 | 269 | +1 | 1 | +269 | 282,2 | 13,2 |
| 2024 | 333 | +2 | 4 | +666 | 322,9 | 10,1 |
| TOTAL | 966 | 0 | 10 | 407 | 966 | 28 |

$$a = \frac{\sum_{i=1}^{n}\omega_i \sum_{i=1}^{n} t_i^2 - \sum_{i=1}^{n}\omega_i t_i \sum_{i=1}^{n} t_i}{n\sum_{i=1}^{n} t_i^2 - \left(\sum_{i=1}^{n} t_i\right)^2} = \frac{966 \cdot 10}{4 \cdot 10} = 241{,}5$$

$$b=\frac{n\sum_{i=1}^{n}\omega_i t_i-\sum_{i=1}^{n}t_i\sum_{i=1}^{n}\omega_i}{n\sum_{i=1}^{n}t_i^{\,2}-\left(\sum_{i=1}^{n}t_i\right)^2}=\frac{4\cdot 407}{4\cdot 10}=40{,}7$$

$$v_I=\left[\frac{\sum_{i=1}^{n}\left|\omega_i-\omega_{t_i}^{I}\right|}{n}:\frac{\sum_{i=1}^{n}\omega_i}{n}\right]\cdot 100=\frac{\sum_{i=1}^{n}\left|\omega_i-\omega_{t_i}^{I}\right|}{\sum_{i=1}^{n}\omega_i}\cdot 100=\frac{28}{966}\cdot 100=2{,}90\%$$

✧ if the inflow of data concerning the $\omega$ variable, where $\omega$ = the powers's sizes of the implemented infrastructures which stocked the photovoltaic energy in the E.U., generate a quadratic $\omega_{t_i}=a+b\cdot t_i+ct_i^2$, than a and b will be [4]:

**Table 11. The display of the data regarding the powers's sizes for the implemented infrastructures which stocked the photovoltaic energy in the E.U., if these reflect a quadratic equation**

| YEARS | THE POWERS'S SIZES FOR THE IMPLEMENTED INFRASTRUCTURES WHICH STOCKED THE PHOTOVOLTAIC ENERGY IN THE E.U. (gigawatts) $(\omega_i)$ | PARABOLIC TREND | | | | | |
|---|---|---|---|---|---|---|---|
| | | $t_i$ | $t_i^2$ | $t_i^4$ | $t_i^2\omega_i$ | $\omega_{t_i}=a+bt_i+ct_i^2$ | $\left\|\omega_i-\omega_{t_i}\right\|$ |
| 2021 | 164 | -2 | 4 | 16 | 656 | 167,1 | 3,1 |
| 2022 | 200 | -1 | 1 | 1 | 200 | 193,8 | 6,2 |
| 2023 | 269 | +1 | 1 | 1 | 269 | 275,2 | 6,2 |
| 2024 | 333 | +2 | 4 | 16 | 1332 | 329,9 | 3,1 |
| TOTAL | 966 | 0 | 10 | 34 | 2457 | 966 | 18,6 |

$$a=\frac{\sum_{i=1}^{n}t_i^4\sum_{i=1}^{n}\omega_i-\sum_{i=1}^{n}t_i^2\sum_{i=1}^{n}t_i^2\cdot\omega_i}{n\sum_{i=1}^{n}t_i^{\,4}-\left(\sum_{i=1}^{n}t_i^2\right)^2}=\frac{34\cdot 966-10\cdot 2457}{4\cdot 34-10^2}=229{,}8333333$$

$$b=\frac{\sum_{i=1}^{n}\omega_i t_i}{\sum_{i=1}^{n}t_i^{\,2}}=\frac{407}{10}=40{,}7$$

$$c=\frac{n\cdot\sum_{i=1}^{n}t_i^2\cdot\omega_i-\sum_{i=1}^{n}t_i^2\cdot\sum_{i=1}^{n}\omega_i}{n\sum_{i=1}^{n}t_i^{\,4}-\left(\sum_{i=1}^{n}t_i^2\right)^2}=\frac{4\cdot 2457-10\cdot 966}{4\cdot 34-10^2}=4{,}666666667$$

$$v_{II}=\left[\frac{\sum_{i=1}^{n}\left|\omega_i-\omega_{t_i}^{II}\right|}{n}:\frac{\sum_{i=1}^{n}\omega_i}{n}\right]\cdot 100=\frac{\sum_{i=1}^{n}\left|\omega_i-\omega_{t_i}^{II}\right|}{\sum_{i=1}^{n}\omega_i}\cdot 100=\frac{18{,}6}{966}\cdot 100=1{,}92\%$$

✧ if the inflow of data concerning the $\omega$ variable, where $\omega$ = the powers's sizes of the implemented infrastructures which stocked the photovoltaic energy in the E.U., generate an exponential equation $\omega_{t_i}=ab^{t_i}$, than a and b will be [4]:

**Table 12. The display of the data regarding the powers's sizes for the implemented infrastructures which stocked the photovoltaic energy in the E.U., if these reflect an exponential equation**

| YEARS | THE POWERS'S SIZES FOR THE IMPLEMENTED INFRASTRUCTURES WHICH STOCKED THE PHOTOVOLTAIC ENERGY IN THE E.U. (gigawatts) $(\omega_i)$ | EXPONENTIAL TREND | | | | | |
|---|---|---|---|---|---|---|---|
| | | $t_i$ | $\lg \omega_i$ | $t_i \lg \omega_i$ | $\lg \omega_{t_i} = \lg a + t_i \lg b$ | $\omega_{t_i} = ab^{t_i}$ | $\lvert\omega_i - \omega_{t_i}\rvert$ |
| 2021 | 164 | -2 | 2,214843848 | -4,429687696 | 2,218232979 | 165,2848237 | 1,3 |
| 2022 | 200 | -1 | 2,301029996 | -2,301029996 | 2,292625284 | 196,1666990 | 3,8 |
| 2023 | 269 | +1 | 2,429752280 | +2,429752280 | 2,441409894 | 276,3184563 | 7,3 |
| 2024 | 333 | +2 | 2,522444234 | +5,044888467 | 2,515802200 | 327,9458957 | 5,1 |
| TOTAL | 966 | 0 | 9,468070357 | 0,743923055 | | | 17,5 |

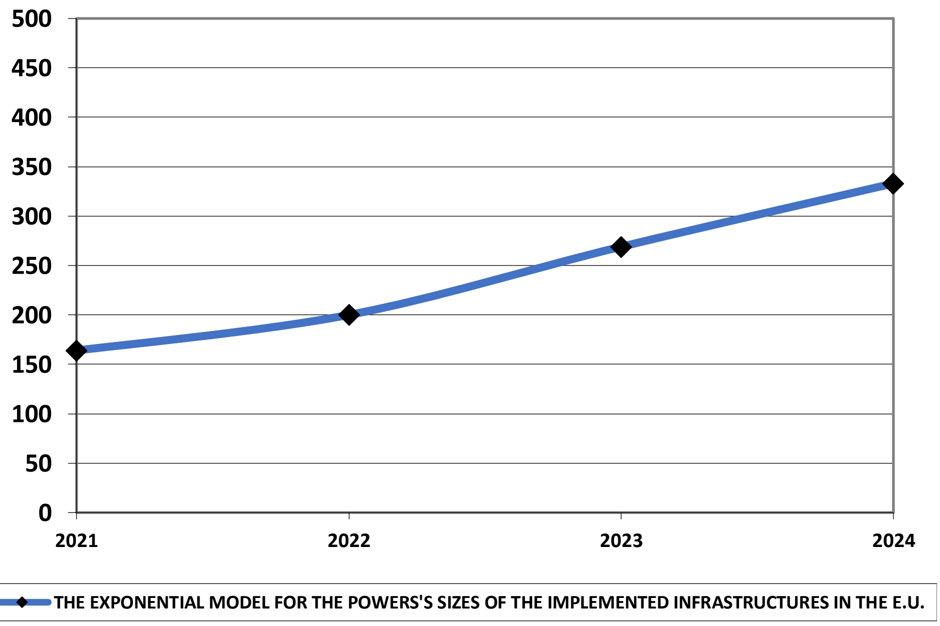
$$\lg a = \frac{\sum_{i=1}^{n} \lg \omega_i \sum_{i=1}^{n} t_i^2 - \sum_{i=1}^{n} t_i \lg \omega_i \sum_{i=1}^{n} t_i}{n\sum_{i=1}^{n} t_i^2 - \left(\sum_{i=1}^{n} t_i\right)^2} = \frac{9,468070357 \cdot 10}{4 \cdot 10} = 2,367017589$$

$$\lg b = \frac{n \cdot \sum_{i=1}^{n} t_i \lg \omega_i - \sum_{i=1}^{n} \lg \omega_i \sum_{i=1}^{n} t_i}{n\sum_{i=1}^{n} t_i^2 - \left(\sum_{i=1}^{n} t_i\right)^2} = \frac{4 \cdot 0,743923055}{4 \cdot 10} = 0,074392305$$

$$v_{\exp} = \left[\frac{\sum_{i=1}^{n} \left|\omega_i - \omega_{t_i}^{\exp}\right|}{n} : \frac{\sum_{i=1}^{n} \omega_i}{n}\right] \cdot 100 = \frac{\sum_{i=1}^{n} \left|\omega_i - \omega_{t_i}^{\exp}\right|}{\sum_{i=1}^{n} \omega_i} \cdot 100 = \frac{17,5}{966} \cdot 100 = 1,81\%$$

$$v_{\exp} = 1,81\% < v_{II} = 1,92\% < v_I = 2,90\%$$

The values concerning the powers's sizes for the implemented infrastructures which stocked the photovoltaic energy in the European Union depict an exponential „itinerary" $\omega_{t_i} = ab^{t_i}$




**Graph 3. The depiction of the exponential pattern regarding the powers's sizes for the implemented infrastructures which stocked the photovoltaic in the European Union between 2021-2024**

$$\omega_{2025}^{SOLAR\_PHOTOVOLTAIC\_CAPACITY\_E.U.} = 232{,}8185548 \cdot 1{,}186840356^{3} = 389\_gigawatts$$
$$\omega_{2026}^{SOLAR\_PHOTOVOLTAIC\_CAPACITY\_E.U.} = 232{,}8185548 \cdot 1{,}186840356^{4} = 462\_gigawatts$$
$$\omega_{2027}^{SOLAR\_PHOTOVOLTAIC\_CAPACITY\_E.U.} = 232{,}8185548 \cdot 1{,}186840356^{5} = 548\_gigawatts$$
$$\omega_{2028}^{SOLAR\_PHOTOVOLTAIC\_CAPACITY\_E.U.} = 232{,}8185548 \cdot 1{,}186840356^{6} = 651\_gigawatts$$
$$\omega_{2029}^{SOLAR\_PHOTOVOLTAIC\_CAPACITY\_E.U.} = 232{,}8185548 \cdot 1{,}186840356^{7} = 772\_gigawatts$$
$$\omega_{2030}^{SOLAR\_PHOTOVOLTAIC\_CAPACITY\_E.U.} = 232{,}8185548 \cdot 1{,}186840356^{8} = 916\_gigawatts$$

## 6. Conclusions

We can see that, in the period 2025-2030, the global production of photovoltaic energy will rise from 2269,18 terawatts-hours in 2025, to 4265,36 terawatts-hours in 2030. In the same interval of time, the powers's sizes of the implemented infrastructures which will stock photovoltaic energy will increase from 2,47 terawatts in 2025, to 7,97 terawatts in 2030. Also, we can say with accuracy that, between 2025-2030, the powers's sizes of the implemented infrastructures in the European Union, which will stock the photovoltaic energy, will raise from 389 gigawatts in 2025, to 916 gigawatts in 2030.

The implications in practice regarding this statistical study consist in to invite the public and private sector at the utility of the technology which transform the light photons in electrical energy, because through this photovoltaic technology, the dynamic of the global energy crisis can be diminished and, in this sense, the present research reflects that the global production of solar photovoltaic energy will be growing between 2025-2030. This solar photovoltaic technology conquered giant segments at worldwide level and there is an exponential tendency in the implementations of the infrastructures concerning the installed powers at the global and European Union level.

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