# ECONOMIC ANALYSIS OF A PHOTOVOLTAIC SYSTEM

Mihaela Florentina SUCHÁNKOVÁ[1], Mihai Octavian POPESCU[2]

*The purpose is the analysis of the efficiency of a photovoltaic plant and working with the mathematical methods as a result of the study on the legislation. The outputs of the study can be summarized as follows: through mathematical methods and a case study for the installation from Chotysany, stands out the possibility of getting a better return depending on method of calculation adopted and according to the legislation stands costs of using such a system. Also it is also made a comparative study between the policies implemented.*

*The study is current, a result of research projects, the aspects mentioned are original.*

**Keywords:** mathematical methods, legislation, photovoltaic system

## 1. Introduction

The framework for the studies which lead to this article, among other results, is the legislation valid in Czech Republic related with renewable sources of energy [1]. As it was proved by the latest directions of research, this research area is one of the most interesting, because of the importance of the renewable sources of energy as a result of the rapid depletion of conventional energy sources while the demand is rapidly increasing.

In the present time this domain is labeled as an important domain of interest. According to the International Energy Agency, current trends of renewable energy sources will collectively overtake gas as the world's second-largest source of energy by the end of this decade [2].

Renewable sources of energy are the fastest-growing energy sector, and an estimated increase in generation capacity of 40 percent over the next five years will mean that by 2018 a quarter of all energy generated globally will come from one of these sources.

Thus, in the near future renewable energy industry will become the most important and powerful economic branch and therefore, the interest of specialists in research on this area is enhanced and supported. Every project which includes, in any form renewable sources of energy, benefits of important financial support and, as a results, the last years development was fast and had significant results.

In the last years, the new projects were more and more sustained by the legislation, many studies were done to avoid any barrier for further development of RES [3]. This is the reason for which the related legislation have been suffering

[1] Faculty of Electrical Engineering, University POLITEHNICA of Bucharest, Romania, E-mail: mihaela.suchankova@seznam.cz

[2] Professor, Faculty of Electrical Engineering, University POLITEHNICA of Bucharest, Romania, E-mail: mo_popescu@rectorat.pub.ro

many changes rapidly in the last years [4]. A new legislation is applied in Czech Republic since 1st January 2013 [5]. The new projects are still sustained but the largest ones already face difficulties [8], mainly because of network connection.

In this article, we analyze the legislation from the financial and economical point-of-view and the policies applied. The study is interesting because it is applying the valid legislation in Czech Republic (feed-in tariffs and green bonus), the same legislation applied in Germany and Spain but different than the one applied in Romania (obligatory quotas combined with green certificates).

## 2. Economical model of a PV system and methods of calculation

Everyone who has an interest in using green energy has an interest in savings. Savings by using a photovoltaic station includes a correct analysis provided by analyzing all the financial aspects and, to be precise, using mathematical methods [9], [10].

The model for calculation methods has as inputs the characteristics of the PV station (depends on the environment, used modules' characteristics or the devices). Another input reflects the law applied to the functional photovoltaic stations and it depends on the location, the year of installation and the energy consumption, which also depends on the company rules for usage of the produced energy.

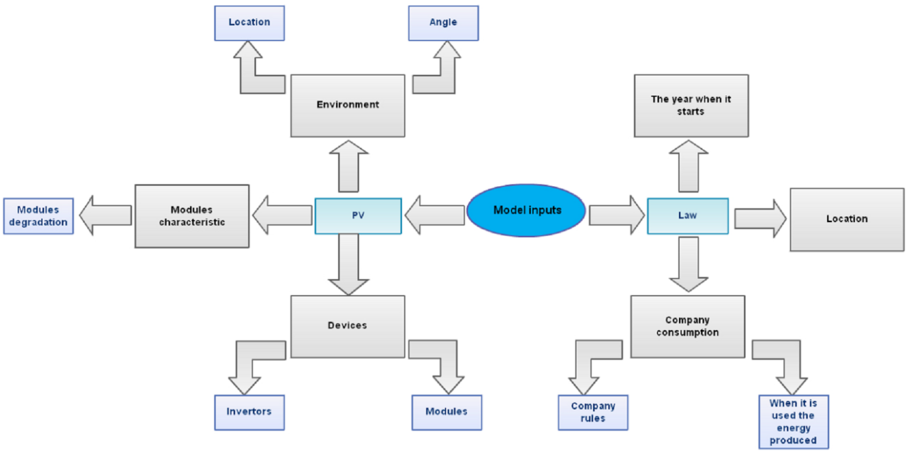


Fig. 1. Block diagram of the inputs of the mathematical model

The legislation part and its inputs will be analyzed first. The charts in Figure 1 and Figure 2 describe the theoretical model taking into consideration the location and the legislation applied to the specific location, and the possible modes of operation, in the paper called policies (from consumption and producing energy). The related model with its calculation methods is than applied on a specific case, in Chotysany in the Czech Republic, where a photovoltaic station is installed.

In Figure 1 is the model for calculation methods which has as inputs the parameters of the photovoltaic station (which depends on the environment, modules characteristics or the devices used). Another input refers to the law which is applied for the functional photovoltaic stations and it depends on the location, the year of installation and the consumption of energy which is also depending on the company rules and how it is planned to use the produced energy.

To present and describe the model on how a station works in relation with inputs and outputs of energy, taxes and payments, the Figure 2 and an example are provided. They illustrate the block diagram for a station of 16 kW (an example) which works in two considered policies, either in “green bonus” or, in the selling the produced energy policy (feed-in tariffs).

Where *Selling* the income from selling the energy produced per kW; this income calculated per total is *Asup* ; $Acons_{HT}$ the payment made for the consumption, per kW, from the FV station, during the time when the high tariff is applied; $Acons_{LT}$ the payment for consuming the energy produced, per kW, by FV station, during the time when the low tariff is applied; *SS* the payment for regular systematic service; *OZE* tax paid to OZE; *OTE* tax paid to OTE; *Tax* another taxes; *CEZsell* income for the energy produced and sold to CEZ; $Cons_{PV}$ the payment made for the consumption, per kW, from the FV station, per total; $Bsup_{GB}$ the income for the delivered energy, according to the policy applied. For the company located in Chotysany – green bonus policy.

The source of information was a Czech company and we maintain the currency in Czech crowns. The exchange rate with EUR for 2011 was 1 EUR = 24.755 Czech Crowns (CZK).

## 3. **Case study on the installed system**

The considered 170 kWp photovoltaic station is located in Chotysany in the Czech Republic. The photovoltaic panels are mounted on the roof facing two different directions – there are 333 photovoltaic modules with the declination angle of 12 degrees in one direction of the roof, and another set of 180 photovoltaic modules with the declination angle of 30 degrees. On another direction of the roof are 225 modules with a declination angle of 12 degrees.

Testing the model described above, from the legislation point of view, we have the chart as in Figure 2 and calculations in Tab. 1 and Tab. 2.

Where:

a) The mentioned “monthly fee”, is a fix monthly payment, paid per connection, per maximum power input.
b) A = is the company Chotysany which has an installed PV station and supplies to the network 97 569 kWh and consumes from the network at high tariff (HT) = 972 kWh and consumes at low tariff (LT)= 111 000 kWh.
c) B = photovoltaic station which produces 151 740 kWh.
d) C = consumer which consumes from PV an amount of 54 171 kWh (consum in the HT = 171 kWh and in the LT = 54 000 kWh), the rest covers it from the network.

The word “constant” means that it is the same price for the whole Czech Republic (no matter if we are speaking about a large consumer or reduced consumption, household or company). The only difference that occurs between households and companies appears depending on the area in which they are (PRE in Prague, EON in South, CEZ in rest of the country). But the constant costs are the same for all three companies (PRE, EON or CEZ).

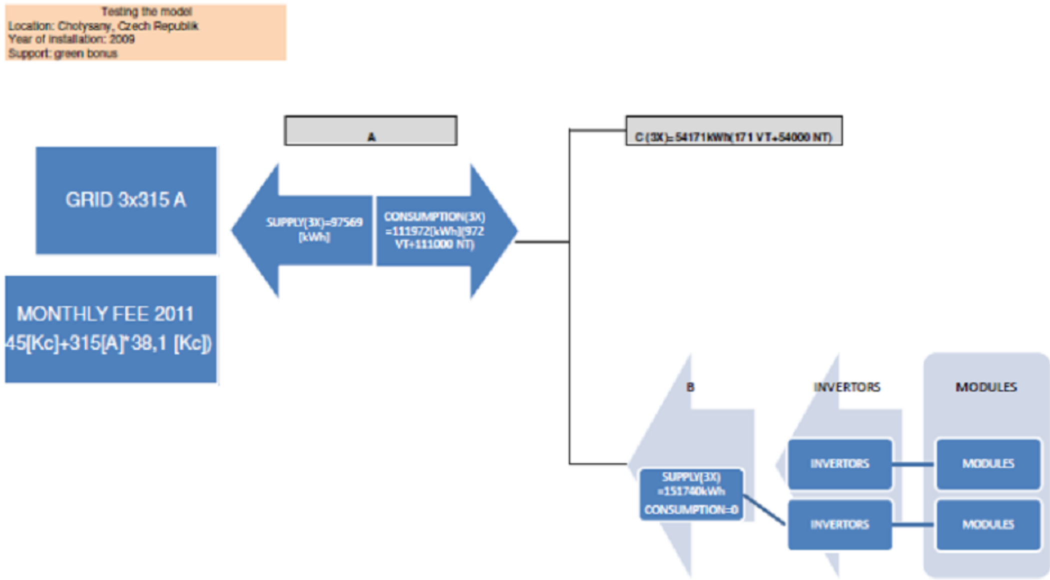


FIG. 2. Block diagram of the model for Chotysany

| Selling | A con HT | A con LT | SS | OZE | OTE | Tax | CEZ SELL |
|---|---|---|---|---|---|---|---|
| 12.32 | -2.07638 | -1.63251 | -0.1554 | -0.578 | -0.475 | -0.0283 | 0.4 |

TABLE 1. Data from 2011 in CZK concerning payments, taxes, incomes for Chotysany, – means costs, + means income. Unit: Czech Crowns

| A Sup | A Con HT | A Con LT | Con PV | B Sup GB | Total amount |
|---|---|---|---|---|---|
| 39028 | -3220 | -318482 | -66993 | 1869437 | 1519768.50 |

TABLE 2. Calculation for data from 2011 concerning payments, taxes, incomes for Chotysany, – means costs, + means income. Unit: Czech Crowns

There are two types of rates for energy and power consumption, high price usually during the day, and low price, usually at night (not related to time itself but the signals from stations that control your device installed). All prices are set by the ERU (`www.eru.cz`) every year and it is forbidden to sell at different prices.

The data in table 3 represent a practical example of showing how the block diagram (Figure 3) works. The unit for all data are in kW, showing what are the costs and incomes which will be paid per kWh.

Where: $PV$ the energy produced by PV station, $Device$ the consumption needed, $A{-}Suppl$ the energy supplied to the network, $A{-}Cons$ the energy consumed from the network, $OTE$ tax paid to OTE, $Fees$ other taxes, $ConfromPV$ the consumption from PV station.

| **PV** (kW) | **Device** (kW) | **A-Suppl.** (kWh) | **A-Cons.** (kWh) | **OTE** (kWh) | **Fees** – | **Con from PV** (kWh) |
|---|---|---|---|---|---|---|
| – | – | income | payment | payment | – | income |
| 0 | 0 | – | – | – | x | – |
| 0 | 10 | 0 | 10 | 0 | x | 0 |
| 1 | 10 | 0 | 9 | 1 | x | 1 |
| 10 | 10 | 0 | 0 | 10 | x | 10 |
| 15 | 10 | 5 | 0 | 15 | x | 10 |
| 16 | 0 | 16 | 0 | 16 | x | 0 |
| 16 | 15 | 6 | 5 | 16 | x | 5 |

Table 3. An example of working system, Czech Republic

In Czech Republic are two types of support available. The difference in taxes will be seen as follows: for "selling the energy produced", the taxes are the ones seen except the last column. In case of "green bonus" we take into consideration also the last column.

Continuing the previous calculation, using mathematical equations according to the legislation applied, according to the internal operational rules of the company Chotysany, we have the following results for: the savings made when it is used the energy produced by the photovoltaic station, see Section 3.**1** and a comparison between models: selling prices for electricity and green certificates, see Section 3.**2**.

This modeling takes into consideration the consumption based on time or according to the rules (for example how it is used the energy produced), which than establishes the type of the tariff which will be applied for one specific company.

Chotysany has, through a signed contract, established an amount of 16-20 hours per day at low tariff. They use the energy mainly for heating, for which they will have established a tariff for the energy consumed from the network, the energy consumed from the PV station or sold to the network. Because they use the energy mainly for heating, they can have a larger period for working at low tariff because from the economical point of view, they are to be wanted, they are using the heating for longer period than another type of consumers (light, computers and so on).

### 3.1. The savings made when the energy produced by the photovoltaic station is used within the factory

The model, as its inputs, considers the energy produced by a photovoltaic station, the prices for consuming from the network, the prices for using the energy produced, and taxes. Data mentioned above is available since 2009 when the PV started producing the energy, until 2012. The other years in the Table 4, i.e. the years from 2014 till 2034, are estimated based on real calculations under an assumption of the current legislation.

The results from Table 4 are calculated based on data, representing the costs for buying electricity from the distributor, costs for selling the energy produced, taxes. All these information are established yearly by ERU - European Regulatory Office.

The following equations illustrate the cost paid in Czech Republic and, the main aims is to have an equation for the savings made when using the energy produced by PV station for consumption:

$$a_0 = b_i - c_i \tag{1}$$
$$a_i = 0.05\ a_{i-1} \tag{2}$$
$$c_i = b_i - a_i \tag{3}$$

where $i$ = 0,1,2,3,..25, representing each year of those 25 years for which the modeling is done, $a_i$ is the difference in between the policies used (selling the energy produced and green bonus), $b_i$ is the buying price, and $c_i$ is the tariff for using the green bonus policy, all three set by ERU.

$$d_i = d_{i-1} \tag{4}$$
$$e_i = e_{i-1} \tag{5}$$

where $d_i$ and $e_i$ are the cost paid to CEZ at the high tariff or at low tariff.

$$f_i = 0.02\ f_{i-1} \tag{6}$$
$$g_i = 0.02\ g_{i-1} \tag{7}$$
$$h_i = 0.02\ h_{i-1} \tag{8}$$
$$j_i = 0.02\ j_{i-1} \tag{9}$$

where $f_i$ is the collection point where the dates are collected monthly, $g_i$ and $h_i$ represents CEZ distribution costs at high tariff or low tariff, and $j_i$ represents CEZ distribution costs, monthly.

$$k_i = 0.02\ k_{i-1} \tag{10}$$
$$l_i = 0.02\ l_{i-1} \tag{11}$$
$$m_i = 0.02\ m_{i-1} \tag{12}$$
$$n_i = 0.02\ n_{i-1} \tag{13}$$
$$o_i = 0.02\ o_{i-1} \tag{14}$$
$$p_i = 0.02\ p_{i-1} \tag{15}$$

where $k_i$ represents the taxes for system services, $l_i$ represents OZE tax, $m_i$ represents OTE tax, $n_i$ represents another taxes, $o_i$ represents the tariff for selling to CEZ, and $p_i$ represents the selling of uncentralized production of energy.

The source of information was a czech company and we mentain the currency in czech crowns. The exchange rate with euros, for 2011, was: 1 euro = 24,755 czech crowns.

$$C_{CEZ,VT} = d_i + g_i + k_i + l_i + m_i + n_i \tag{16}$$

$$C_{CEZ,yearly} = 12\ (j_i + f_i) \tag{17}$$

where $C_{CEZ,VT}$ represents the cost for taking energy from CEZ, high tariff, $C_{CEZ,Yearly}$ represents the cost for taking energy from CEZ, yearly.

$$C_{FV} = k_i + l_i + m_i \tag{18}$$

| | | Paym 1 | | | Paym 2 | Paym 3 | Paym 4 | |
|---|---|---|---|---|---|---|---|---|
| Year ID | Year | HT | LT | yearly | | | HT | LT |
| | | (CZK) | (CZK) | (CZK) | (CZK) | (CZK) | (CZK) | (CZK) |
| 0 | 2009 | −0.19 | −0.19 | – | −0.19 | – | – | – |
| 1 | 2010 | −0.19 | −0.19 | – | −0.19 | – | – | – |
| 2 | 2011 | −0.22 | −0.22 | – | −0.19 | – | 0.03 | 0.03 |
| 3 | 2012 | −2.60 | −2.13 | −135 486 | −0.20 | 0.36 | 2.04 | 1.57 |
| 4 | 2013 | −2.67 | −2.05 | −135 486 | −0.33 | 0.36 | 1.98 | 1.36 |
| 5 | 2014 | −2.84 | −2.40 | −144 558 | −0.74 | 0.36 | 1.74 | 1.30 |
| 6 | 2015 | −2.81 | −2.38 | −147 960 | −0.57 | 0.30 | 1.94 | 1.51 |
| 7 | 2016 | −2.83 | −2.39 | −150 919 | −0.58 | 0.36 | 1.88 | 1.44 |
| 8 | 2017 | −3.02 | −2.58 | −153 938 | −0.77 | 0.36 | 1.89 | 1.44 |
| 9 | 2018 | −3.04 | −2.59 | −157 016 | −0.79 | 0.36 | 1.89 | 1.45 |
| 10 | 2019 | −3.06 | −2.61 | −160 157 | −0.80 | 0.36 | 1.90 | 1.45 |
| 11 | 2020 | −3.09 | −2.63 | −163 360 | −0.82 | 0.36 | 1.90 | 1.45 |
| 12 | 2021 | −3.11 | −2.65 | −166 627 | −0.83 | 0.36 | 1.91 | 1.45 |
| 13 | 2022 | −3.13 | −2.66 | −169 960 | −0.85 | 0.36 | 1.92 | 1.45 |
| 14 | 2023 | −3.15 | −2.68 | −173 359 | −0.87 | 0.36 | 1.92 | 1.45 |
| 15 | 2024 | −3.18 | −2.70 | −176 826 | −0.88 | 0.36 | 1.93 | 1.45 |
| 16 | 2025 | −3.20 | −2.72 | −180 362 | −0.90 | 0.36 | 1.93 | 1.45 |
| 17 | 2026 | −3.22 | −2.74 | −183 970 | −0.92 | 0.36 | 1.94 | 1.46 |
| 18 | 2027 | −3.25 | −2.76 | −187 649 | −0.94 | 0.36 | 1.95 | 1.46 |
| 19 | 2028 | −3.27 | −2.78 | −191 402 | −0.96 | 0.36 | 1.95 | 1.46 |
| 20 | 2029 | −3.30 | −2.80 | −195 230 | −0.97 | 0.36 | 1.96 | 1.46 |
| 21 | 2030 | −3.32 | −2.82 | −199 135 | −0.99 | 0.36 | 1.97 | 1.46 |
| 22 | 2031 | −3.35 | −2.84 | −203 117 | −1.01 | 0.36 | 1.97 | 1.46 |
| 23 | 2032 | −3.38 | −2.86 | −207 180 | −1.03 | 0.36 | 1.98 | 1.46 |
| 24 | 2033 | −3.41 | −2.88 | −211 323 | −1.05 | 0.36 | 1.99 | 1.47 |
| 25 | 2034 | −3.43 | −2.91 | −215 550 | −1.08 | 0.36 | 1.99 | 1.47 |
| | | −3.46 | −2.93 | −219 861 | −1.10 | 0.36 | 2.00 | 1.47 |
| | | −3.49 | −2.95 | −224 258 | −1.12 | 0.36 | 2.01 | 1.47 |
| | | −3.52 | −2.98 | −228 743 | −1.14 | 0.36 | 2.02 | 1.47 |

TABLE 4. Savings per kWh made while using a photovoltaic station; Paym 1 = Payment for taking electricity from CEZ, Paym 2 = Payment for consuming from PV, Paym 3 = Income when selling to CEZ, Paym 4 = Savings when consuming from PV, HT = high tariff, LT = low tariff

where $C_{FV}$ represents the cost paid for consuming from photovoltaic station.

$$P_{CEZ} = o_i + p_i \tag{19}$$

where $P_{CEZ}$ represents the payment received when it is sold to CEZ.

In the end, the equation that describes the savings made while using the PV station for consumption, according to the legislation is:

$$\begin{aligned} E_{PV,VT} &= -P_{CEZ} + C_{FV} - C_{CEZ,VT} = -(o_i + p_i) + \\ &+ (k_i + l_i + m_i) - (d_i + g_i + k_i + l_i + m_i + n_i) = \\ &= -o_i - p_i - d_i - g_i - n_i \end{aligned} \tag{20}$$

### 3.2. Comparison between models: selling prices for electricity and green certificates

The inputs are data which will stay unchanged for the model which does estimation for 20 years, specifically the total production of energy (equal to 151 740 kWh) and the energy to the network (equal to 97 569 kWh). Consumption from PV station during the time when we have two types of tariffs: consumption in the high tariff = 171 kWh and consumption in the low tariff = 54 000 kWh. Consumption from the network during the time when we have two types of tariffs: consumption in the high tariff = 972 kWh and consumption in the low tariff = 111 000 kWh.

First policy analysed will be the policy of selling the energy produced. The company will pay taxes and payments as follows:

$$Support_{OZE} = costbuyingERU * Totalproduction \tag{21}$$

$$Support_{OZE_{2011}} = 13.32 * 151740 = 2021177CZK \tag{22}$$

$$Tax = -0.26\ Support_{OZE} \tag{23}$$

$$Tax_{2011} = -0.26 * 2021177 = -525506CZK \tag{24}$$

$$Supporttax = Support_{OZE} + Tax \tag{25}$$

$$Supporttax_{2011} = 2021177 - 525506 = 1495671CZK \tag{26}$$

$$\begin{aligned} Costconsum * network_{HT} &= Electricitycost_{CEZ,HT} * Consum * FV_{HT} + \\ &+ Consum * network_{VT} \end{aligned} \tag{27}$$

$$Costconsum * network_{HT,2011} = -2.84(171 + 972) = -3249CZK \tag{28}$$

$$\begin{aligned} Costconsum * network_{HT} &= Electricitycost_{CEZ,LT} * Consum * FV_{LT} + \\ &+ Consum * network_{LT} \end{aligned} \tag{29}$$

$$Costconsum * network_{LT,2011} = 2.40(54000 + 111000) = -395828CZK \tag{30}$$

If the company decides for the second type of policy, green bonus policy, than the taxes and payments will be:

$$Support_{OZE} = Greenbonus_{ERU} * totalproduction \tag{31}$$

$$Support_{OZE,2011} = 11.81 * 151740 = 1869437CZK \tag{32}$$

$$Tax = -0.28\ Support_{OZE} \tag{33}$$

TABLE 5. Comparison in between the models

| **Year ID** | **Year** | **Selling – Green bonus** | **Year ID cont.** | **Year** | **Selling – Green bonus** |
|---|---|---|---|---|---|
| 0 | 2009 | −80 014 CZK | 13 | 2022 | 10 708 CZK |
| 1 | 2010 | −65 035 CZK | 14 | 2023 | 22 865 CZK |
| 2 | 2011 | −79 511 CZK | 15 | 2024 | 35 665 CZK |
| 3 | 2012 | −76 431 CZK | 16 | 2025 | −259 877 CZK |
| 4 | 2013 | −110 799 CZK | 17 | 2026 | −261 140 CZK |
| 5 | 2014 | −66 837 CZK | 18 | 2027 | −262 428 CZK |
| 6 | 2015 | −58 819 CZK | 19 | 2028 | −263 743 CZK |
| 7 | 2016 | −50 370 CZK | 20 | 2029 | −265 083 CZK |
| 8 | 2017 | −41 467 CZK | 21 | 2030 | −266 450 CZK |
| 9 | 2018 | −32 088 CZK | 22 | 2031 | −267 845 CZK |
| 10 | 2019 | −22 207 CZK | 23 | 2032 | −269 268 CZK |
| 11 | 2020 | −11 799 CZK | 24 | 2033 | −270 719 CZK |
| 12 | 2021 | −836 CZK | 25 | 2034 | −272 199 CZK |

$$Tax_{OZE,2011} = -0.28 * 1869437 = -523422CZK \tag{34}$$

$$SupportTax = Support_{OZE} + Tax \tag{35}$$

$$SupportTax_{2011} = 1869437 - 523422 = 1345994CZK \tag{36}$$

$$Costcons * network_{VT} \quad = \quad Electricity_{CEZ,VT} * Cons * PV_{VT} \tag{37}$$

$$Costcons * network_{VT,2011} = -2.84 * 171 = -486CZK \tag{38}$$

$$Costcons * network_{NT} \quad = \quad Electricity_{CEZ,NT} * Cons * PV_{NT} \tag{39}$$

$$Costcons * network_{NT,2011} = -2.40 * 54000 = -129544CZK \tag{40}$$

$$Costcons * PV = Costcons_{FV,NT} * Cons_{FV,NT} \tag{41}$$

$$Costcons * PV_{2011} = -0.74 * 54000 = -39960CZK \tag{42}$$

$$\begin{aligned} Costgreenb &= Supportaftertax + Costcons * network_{VT} + \\ &+ Costcons * network_{NT} + Cons * PV \end{aligned} \tag{43}$$

$$\begin{aligned} Costgreenb_{2011} &= 1345994 - 486 - \\ &+ 129554 - 39860 = \\ &= 1176104CZK \end{aligned} \tag{44}$$

If the company, which has an PV system installed, decides for the policy of selling the energy produced, the general equation for the yearly income is:

$$\begin{aligned} SellingEne &= Costcons * network_{VT} + Costcons * network_{NT} + \\ &+ Supportaftertax \end{aligned} \tag{45}$$

$$\begin{aligned} SellingEne &= Electricity_{CEZ,VT} * (Cons * PV_{VT} + Cons * network_{VT}) + \\ &+ Electricity_{CEZ,NT} * (Cons * FV_{NT} + Cons * network_{NT}) + \\ &+ Support_{OZE} + Tax \end{aligned} \tag{46}$$

$$\begin{aligned} SellingEne &= Electricity_{CEZ,VT} * (Cons * PV_{VT} + Cons * network_{VT}) + \\ &+ Electricity_{CEZ,NT} * (Cons * FV_{NT} + Cons * network_{NT}) + \\ &+ Costbuying_{ERU} * TotalProd - 0.26\ Support_{OZE} \end{aligned} \tag{47}$$

If deciding for the policy green bonus:

$$\begin{aligned} Costgreenb &= Supportaftertax + Cons * PV + \\ &+ Costcons * network_{VT} + \\ &+ Costcons * network_{NT} \end{aligned} \tag{48}$$

$$\begin{aligned} Costgreenb &= Support_{OZE} + Tax + \\ &+ Electricity_{CEZ,VT} * Cons * PV_{VT} + \\ &+ Electricity_{CEZ,NT} * Cons * network_{NT} + \\ &+ Costcons_{FV} * Cons * FV_{NT} \end{aligned} \tag{49}$$

## 4. **Conclusion**

The study of current legislation that is the Law 165/2012 [5], leads to the valid policies applied in Czech Republic (the policy concerning selling the energy produced and "green bonus" policy), which will be applied in the case studies made.

No matter which policy is applied, there exist fixed taxes, which are the same no matter the location of the PV station and the energy distributors where they are connected and variable taxes which are paid depending on the energy created and distributed energy, also the year when the station starts to produce energy and the purpose for which the energy produced is used [6].

The fix taxes mean that the same price for the whole Czech Republic (no matter if we are speaking about a large consumer or reduced consumption, household or company) is applied. The only difference that occurs between households and companies appears depending on the area in which they are (PRE in Prague, EON in South, CEZ all the rest). But the constant costs are the same for all three distributors of energy (PRE, EON or CEZ) [7].

For energy and power consumption are two types of rates, the high price, usually during the day, and the low price, usually at night. They are not related to time itself but to the remote signaling from energy distributors that controls your device installed.

After the calculation presented in this paper, the conclusion is that for Chotysany, for the model where we analyze the savings made when using a PV station, the savings are increasing every year and they are higher for “high tariff” regime.

The mathematical comparison in case of Chotysany shows that only in the year 2022 the model where it is applied the “green bonus” policy becomes more advantageous than the policy of selling the energy produced. And only for 3 years.

The new legislation becomes more restrictive when speaking about the energy producers free will (in between those two types of policies). If the producer produces less than 100 kWp, he can pick in between those two types of support. If he produces more than 100 kWp he can pick only the option “green bonus”.

I think that our paper is bringing new results which are not very often done in the research projects. The available studies are about the mathematical methods for calculation, related with photovoltaic systems, as they refer mostly to technical part, technical modelling, computational method for photovoltaic systems, mathematical modelling of the characteristic I(V).

Regarding the technico-economical case studies for engineering of photovoltaic systems there are not many research projects or articles available besides the company brochures and marketing materials, companies which have like main activity offering their services for designing a specific system for the consumer’s needs. Of course that such companies doesn’t offer or doesn’t make a complete overview.

In our opinion the study is useful for companies which are using or planning to use photovoltaic energy to analyze their own efficiency, the possibility of getting a better return depending on method of calculation adopted by using one of the policies valid in the Czech Republic.

## REFERENCES


[1] Information on the important legislation on the support schemes, grid issues and policies for energy from renewable sources, `http://www.res-legal.eu/`.

[2] European Energy Agency, `http://www.iea.org/`.

[3] *K. Garbe, M. Latour and P.M. Sonvilla*, PV Legal, Final Report – Reduction of the bureaucratic barriers for successful PV deployment in Europe, 2012.

[4] Summaries of EU legislation, `http://europa.eu/legislation_summaries/index_en.htm`.

[5] The Law 185/2001, updated `http://business.center.cz/business/pravo/zakony/odpady/cast4.aspx`.

[6] *J. Knapek and Mihaela Florentina Matei*, Internal report for Czech Technical University in Prague –Opportunities and barriers for further deployment of renewable, State of the art of 2008 applied to Romania and Czech Republic, Prague, 2008.

[7] European Regulatory Office, `http://www.eru.cz`.

[8] *Junko Movellan*, Running Out of Precious Land? Floating Solar PV Systems May Be a Solution, `http://www.renewableenergyworld.com/rea/news/article/2013/11/running-out-of-precious-land-floating-solar-pv-systems-may-be-a-solution`.

[9] *Mahendra Lalwani, D.P. Kothari, Mool Singh*, Investigation of Solar Photovoltaic Simulation Softwares, INTERNATIONAL JOURNAL OF APPLIED ENGINEERING RESEARCH, DINDIGUL, Volume 1, No 3, 2010, ISSN-0976-4259.

[10] *Abolfazl Shiroudi and others*, Stand-alone PV-hydrogen energy system in Taleghan-Iran using HOMER software: optimization and techno-economic analysis, Environment, Development and Sustainability , October 2013, Volume 15, Issue 5, pp 1389–1402