EFFECTS OF PHOTOVOLTAIC POWER PLANTS IN ELECTRICITY PRICES FOR CONSUMERS

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Abstract: The paper deals with the issue of the rising prices of electric energy and the impact of photovoltaic power to them. The article attempts to disprove the opinion that the rising energy costs are caused only by photovoltaic sources.

Keywords: Renewable energy, solar power, prices of electicity

1 INTRODUCTION

Currently is mostly mentioned the fact about increasing prices of electric energy. In media are usually discussed reasons and consequences of this increase. The main blame is put on the photovoltaic power stations (PVP or PVE) and their massive development in the years 2010 – 2011. This expansion of PVP create a basis for these opinions.

2 CURRENT STATE AND DEFINITIONS

2.1 ITEMS OF PRICES OF ELECTRIC ENERGY

The prices of electric energy are made of several items:

- The price for electricity distribution
  - contribution to renewable sources of energy, combined heat and electricity, decentralized resources
  - contribution to the operation of OTE (Czech electricity and gas market operator)
  - payment system services (emergency backup sources)
  - monthly charge for the capacity (for circuit breaker)
- The price for electrical energy
  - the electricity power supply (low and high rate)
  - monthly standing charge
- Taxation

Each of this item in the electricity prices can be differentiate according to region (especially in fixed payments). If we want to divide the prices according to regulated and unregulated components, we have to say that the price is made of the only one unregulated component. This unregulated component is the price of energy. This price is determined by stock exchange or market.

If we want electricity, which will be charged each month, we can use various tariffs (such as E.on Trend). In some cases, if we communicate with suppliers electronically, we can get a discount. This discount is only moderate in the order of units percent (or less).

For a better comparison we can give an example of prices for households and businesses. This example is for supplier (understood as a distribution area) E.On. In fact do not care if we consider E.On or ČEZ or PRE, it is only the ratio of the prices.

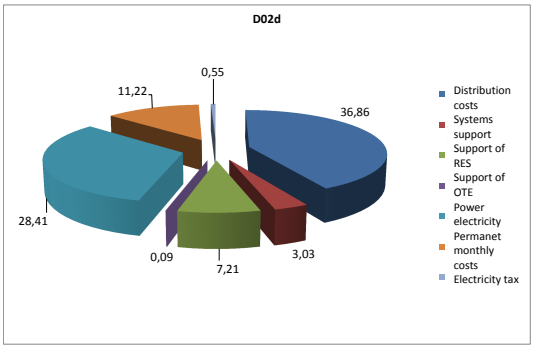

Figure 1: Price for household

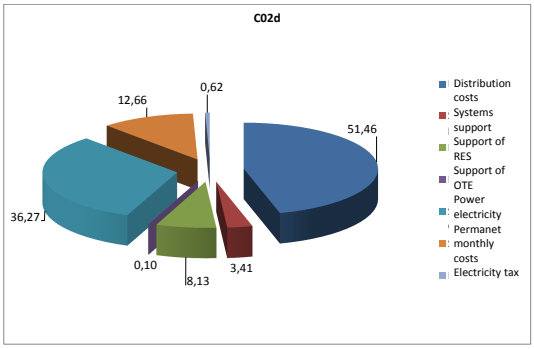

Figure 2: Prices for small business

The data used for graphics were taken from [3] . It is clearly shown that the contribution to RES is no more than 8.21 % for small businesses. Not 30 %, as is presented by some of the media. The data are for the year 2011, where the price was slightly lower.

2.2 GRAPHS AND THE PRICE SPREAD

For comparison of electricity prices, we chose an example of households with an annual consumption 1000 kWh. This household has consumption in the most common rate D02d, live in South Moravia and have to decide between three suppliers of energy (power) - E.On, ČEZ, Amper market. If we look at the distribution of individual components in the graph we will see following.

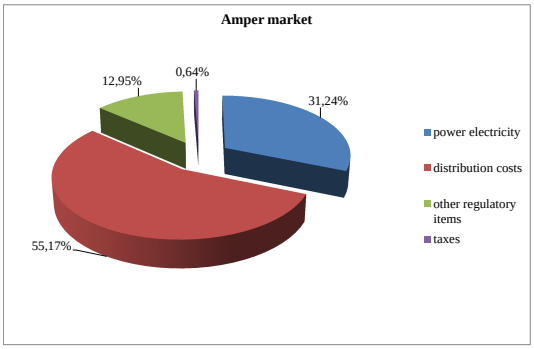

Figure 3: Amper Market

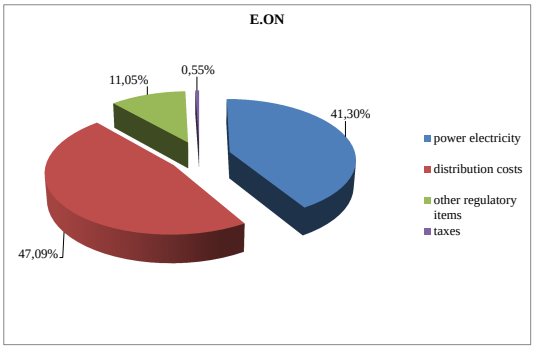

Figure 4: E.On

It is interesting, that each of the supplier charges differnt prices for electrical energy. This prices are based on a market and the current offer on it. Therefore, Amper has the highest portion in the price for the distribution of electricity. The ratio of energy is significantly smaller. It is necessary to express each portions on total price energy.

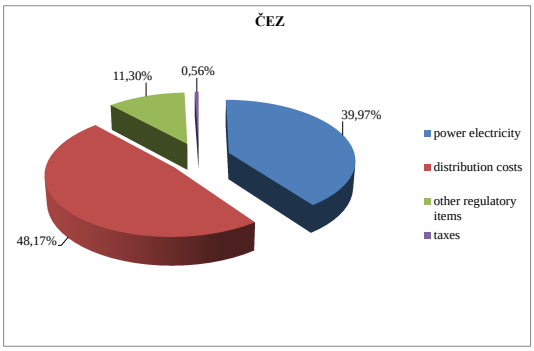

Figure 5: ČEZ, a.s.

Slightly paradoxical is the fact that the price of distribution starts to dominate befor the price of electric energy.Eeven if media are trying to persuade us about the oposite opinion. Another interesting feature is the overall ratio of other regulated components (which includes a contribution to RES). For Amper market it is no more than 12 % (based on total price for electricity. energy). Every company has the same contribution, but the percentage to the total price is different. It is highest at Amper Market (the smallest total amount).

It is necessary to noted that the total price in individual companies, as is shown on Figures 3, 4 and 5, is different. In the following Table 1 is shown the total price in the three above mentioned companies. Table 1 shows that the most inportatnt item, which influence overall price is the price of power energy. This price depends on stock exchange or market.

Item	Currency	E.ON	ČEZ	Amper Market
power electricity	Czech crowns	2556	2418	1650
distibution costs	Czech crowns	3159.06	2914.26	2914.26
Other regulated item	Czech crowns	683.96	683.96	683.96
Taxes	Czech crowns	33.96	33.96	33.96
Total price with VAT (1 MWh)	Czech crowns	6432.98	6050.18	5282.18

Table 1: Price electricity for particular enterprises [3]

3 CALCULATION OF PRICES ASSOCIATED WITH PHOTOVOLTAIC POWER PLANTS

Photovoltaic power plants have produced about 2 TWh of electricity in the last year. As is shown in the following graph in Figure 6, the growth in compared with the last year, is really large.

3.1 CALCULATION

Total energy costs for consumers are increas about 5 % and the biggest part is caused by the photovoltaic plants (PVP, PVE). In media is generally discusses, that the price of electricity is almost made of $\frac{1}{3}$ of contributions for RES. The ratio of production to cost for energy from photovoltaic power plants in comparison to the total gross production, is relatively small. Total gross electricity production according to [2] was 87 560.6 GWh, net from FVE 85 442.5 85 GWh, while the production of FVE was 2 118.1 GWh. The ratio is: 40.34 x. If we take average price for electricity on the stock market, that is currently traded (and from which probably determines the market price and Amper market, which we mentioned in the introduction) and whose price is 51 €/ MWh, in comparison on

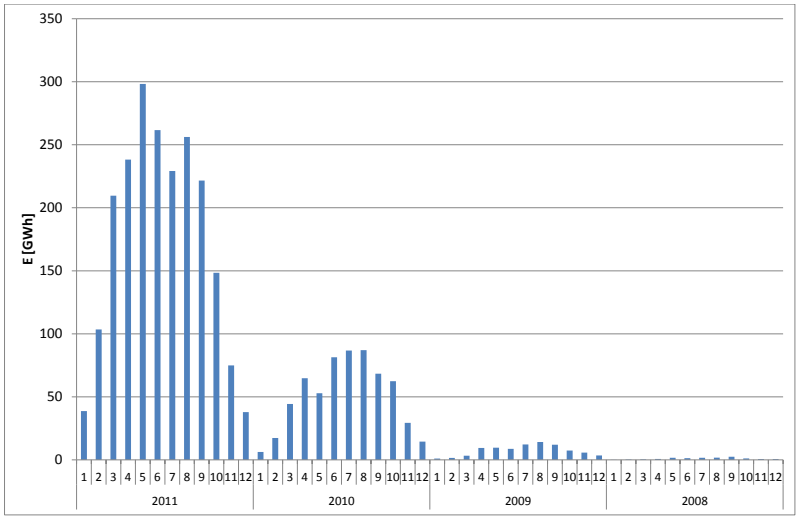

Figure 6: Produced electric energy from PVE between 2008 - 2011 [3]

FVE subsidies net of withholding taxes (26 % for purchase and 28 % for green bonus for FVE with higher output than 30 kWp on the roofs of houses), we will obtain:

- ratio of installed capacity in the rest of power plants to PVE

$$l = \frac{\sum P_{instPVE}}{\sum_{n-1}^{n} P_{inst}(n)} \tag{1}$$

- ratio price of installed capacity in conventional and unconventional (heat plant, nuclear, Geo apod.) power plants to PVE

$$k = \frac{N_{instFVE} . \sum P_{instPVE}}{\sum_{n-1}^{n} N_{inst} . P_{inst}(n)}, \tag{2}$$

  where N - is purchase price from individual source

If ERU in their statistics presents that the gross electricity production for the year 2011 was 87,560.6 GWh (we do not know why at the same time is not considered the production from KVET), we will obtain the ratio l from Equation 1 l = 2.4788 % on total gross production. From equation 2 we can express the ratio of prices of individual energy. Basic parameters for calculation are:

- power electricity price on the stock exchange is 51 €/MWh
- the exchange rate is 25 Czech crowns/€
- current price for electricity from FVE power plant is in 12,650 Czech crowns/MWh (without taxes)

It results in the interesting ratio$k$, which is equal to k = 24,59 %. k – is the ratio of installed capacity of photovoltaic power plants to total installed capacity from point of purchase prices. In the previous year increased price of electricity from PV power plant (and from all of the RES) because of the inflationary clause, as is described in the section below. If we consider aproximately 26 % for tax for supply of electricity to the EC, the coefficient$k$ will be 18.199 %.

3.2 INFLATION CLAUSE

Inflation clause says that the purchase price will be increased by so-called inflationary clause, which is in the range (2–4) %. Inflation for the previous year was 1.9 % according the Czech Statistical Office. Therefore the price of electricity from photovoltaic power plants (and also from all renewable energy sources) could not be increased no more than 2 %. In fact the price of electricity increased on 24.16 %. Earlier prices, which were given in fall 2010, not reflected the real conditions, which occured after construction of photovoltaic power plants.

In Table 3 is calculated with the inflationary clause. It describes the price with supporting of RES which is incresed about inflation, which will be every year just 2 %. This is only a hypothesis and it can be changed by the legislative, the economic changes in those years. Also, some distributors still evaluate the effect of PVE and RES on the market with energy.

Produced of electric energy (GWh):	2118.1
Purchase price (Czech crowns/kWh):	12.5
Total price by RES (billion Czech crowns):	29.7
Suport without taxes (Czech crowns/MWh):	578
Support vwith taxes 26% by PVE (Czech crowns/MWh):	370

Table 2: Parametres of support for RES in year 2011

Table 3 shows the expected prices, which we will pay for promoting renewable sources of energy. Already, in the year 2012, is expected that this price will be higher than the price which is stating today. It is expected that the price will be up to 34 billion crowns. It is necessary take this table apart.

Year	2011	2012	2013	2014	2015	2016	2017	2018
Costs (billions Czech crowns)	29.7	30.3	30.9	31.5	32.1	32.8	33.4	34.1
Year	2019	2020	2021	2022	2023	2024	2025	**Sum**
Costs (billions Czech crowns)	34.8	35.5	36.2	36.9	37.7	38.4	39.2	**514.0**

Table 3: The prices that consumers will pay to support RES for 15 years

4 CONCLUSION

In the final realistic evaluate the situation show that energy prices are currently assessed by many factors. On the market is only dealing with power electricity. Other factors are distribution costs, which increasing. Support of renewable energy in the Czech Republic is enormous cash flow between distributors and producers of electric energy were showed in this article. Some media coverage informs about of photovoltaic plants that price of electricity is composed by 1/3 support of renewable energies. This proposition is not truth. Aggregate fees RES does not represent the accounts of more than 10 %. Purchase prices of electricity the above mentioned is for some sources (example combined producer of electricity and heat) are at half the cost. Pricing is fairly complicated field where many parameters predict only.

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