RENEWABLE ENERGY SOURCES IN THE CZECH REPUBLIC
IMPACT ON TECHNICAL AN ECONOMIC ISSUES

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SUMMARY

For the Czech Republic the Directive 2009/28/EC states the obligation to raise the share of renewable energy in the total gross final energy consumption in the CR to 13 % by 2020 (from 6.1 % in 2005). The 13 % can be covered from the consumed electricity produced from renewable energy sources, from energy used for heating and cooling from renewable energy sources and energy used in transportation that is produced from renewable energy sources. Meanwhile, the increasing of the share of energy from renewable sources in all types of transportation must be, in accordance with the directive, at least 10 % of the final energy consumption in transportation in the Czech Republic by 2020.

The law on the support of renewable sources of energy has established favorable conditions for investors of photovoltaic power plants. The purchase price of electricity from photovoltaic power stations was the highest in Europe and investors from many countries of Europe were building these stations.

By the end of 2011 photovoltaic power plants with installed capacity 2100 MW and wind power plants with installing capacity 220 MW have been connected to all voltage levels of the distribution system.

The technical and economic impacts of the development of photovoltaic power plants are specified in this article.

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KEY WORDS

Photovoltaic power plant, impact, RES, CHEP (combined production of electricity and heat) economy, additional costs, promotion, customer contribution, load daily curve

INTRODUCTION

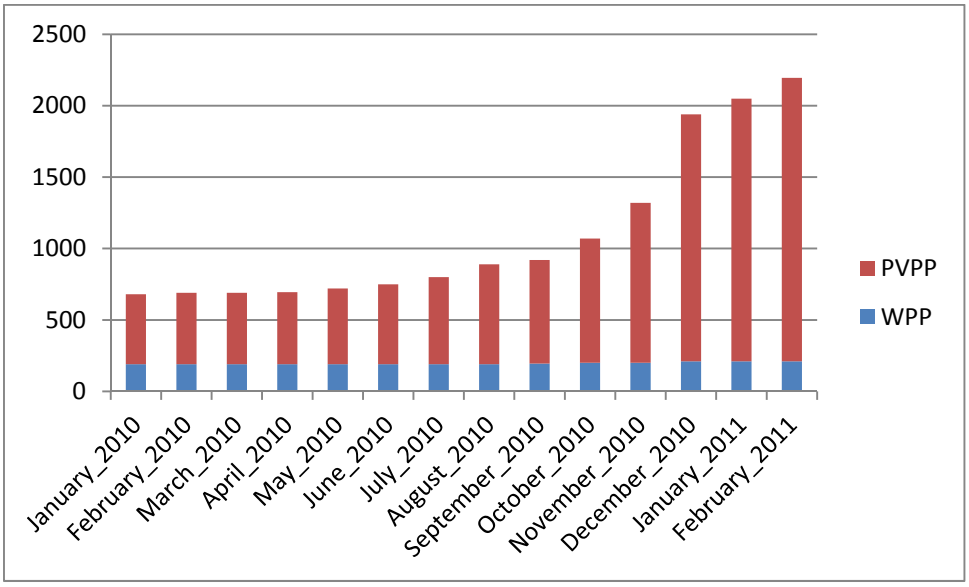
From 2009 distribution networks operators warned government authorities and the experts about technical risks caused by uncontrolled development of electricity generation from photovoltaic and wind energy plants. Prediction of the performance of photovoltaic and wind power plants by the end of 2010 from operators of distribution networks were correct, and have not been overvalued. Forecasts of photovoltaic and wind energy associations were significantly undervalued. As a result of the measures taken on the side of network operators avoid enormous connecting photovoltaic and wind power has to negative phenomena in the transmission systems and distribution networks.

INSTALLED POWER CONNECTED PHOTOVOLTAIC AND WIND POWER PLANTS

At the end of February 2011 have been connected to the power system of the Czech Republic power plants using renewable resources with the installed capacity [1]:

- Photovoltaic Power Plant [PVPP] 1 900 MW
- Wind Power Plant [WPP] 213 MW
- Total 2 113 MW.

The limit for safe and reliable operation of the electricity system in the Czech Republic was filled. Limit means the maximum simultaneous production of photovoltaic and wind power stations in the value of domestic consumption and export, while preserving the power balance the power system of the Czech Republic. Installed capacity of photovoltaic power plants already exceeds the value determined in the National action plan for renewable sources of energy for photovoltaic power plants by 2020. This limit value was set to 1 695 MW. Connectable power limit is the physical quantity and presents own ability of the Czech Republic power system to keep safe and reliable operation.



Source: CSRES

Figure 1 Installed power [MW] of photovoltaic and wind power plant connected to distribution networks in 2010 and 2011

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FACTORS THAT AFFECT THE FURTHER DEVELOPMENT OF POWER GENERATION FROM RES IN THE CZECH REPUBLIC

1. Progress of electricity consumption and structure of this consumption
2. Existing resources structure in the Czech Republic – the availability reserve (support services)
3. Capacity of the distribution network, the transformer links between transmission and distribution systems, and transmission network
    a. Removal of insufficient capacity will only be possible by extending the distribution system, transformer link between transmission and distribution system and transmission system, which needs further investment in the development of these systems.
4. Impacts of the increase of the installed capacity, in particular photovoltaic and wind power plants for the operation of the network
    a. Maintain the frequency of the power system of the Czech Republic (stable balance between consumption and production at any time)
    b. Sufficiency of reactive power during "power supply" area from photovoltaic power plants only (voltage, start of rotating machines
    c. Higher harmonics (a reverse impact to the network as a result of non-linear consumption)

MEASUREMENT AND EVALUATION OF THE IMPACT OF PHOTOVOLTAIC POWER PLANTS TO THE OPERATION OF DISTRIBUTION SYSTEM

Distribution network operators made more than 100 long term measures in low and medium voltage networks from March to July 2011.

A significant effect of photovoltaic power plant on the voltage level was found. In low voltage networks was detected in more than 30 % of the cases and in high-voltage networks in more than 11 % of the cases. Even more considerable influence has been found for exceeding of flicker values. Additional parameters of the quality of electricity were also affected by new sources, but not as substantial as voltage and flicker [3].

The measurement results confirm it is necessary to individually appreciate each connection for every little resource from the point of impact on the quality of electricity for other customers. New rules for connecting new resources are currently processed to the network code amendment. Subsequently will be initiated change of secondary legislation.

IMPACT OF CONNECTING RES TO ECONOMY

The impact of RES in the costs of PPS/PDS and the increase of prices for the customer was addressed in 4 areas [1]:

- impact on the cost of the contribution of customers to cover promotion for RES
- impact on the price of system services
- impact on the price for the network service
- impact on the price deviation, which is reflected in the price of electricity

The biggest impact is in the area of the extra costs in direct support of RES and the related costs of the contribution of customers to cover this promotion for the year 2010 amounted to 6,6 €/MWh. In 2012, the price of the contribution only to RES rises to 24,8 – 29,6 €/MWh, corresponding additional costs for RES 1,1-1,5 milliard €. In the target year 2020 the price of contribution will increas to the level of 27,2 – 36,4 €/MWh, representing increase of 410 to 550 %, corresponding additional costs only to RES will be 1,7 – 2,3 milliard €. The total costs associated with the support of RES for the period up to 2020 will be about 14,8 – 18,8 milliard €.

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The impact of RES into the price of system services is small. It is assumed that from today's prices, the price rises from 6.2 €/MWh to 7.7 €/MWh.

The influence of RES at regulated prices distribution is small amounting to one per cent.

The influence of RES on the increase in price deviations (impact on the growth of the electricity prices) is not negligible. In the average price of electricity may impact of RES represent an increase of 6,3 %, resulting in the average price of electricity (regulated + unregulated part without taxes) means the marginal increase of 3.2%.

Table 1 Additional costs for direct promotion for renewable energy source in the Czech Republic

Additional costs for direct promotion (purchase price and green bonuses)	**2012 Thousand €/year**	**2015 Thousand €/year**	**2020 Thousand €/year**
Wind PP	34 080	1 642 000	2 415 000
Photovoltaic PP	838 560	28 718 000	35 089 000
BIOMASS PP	121 600	3 816 000	5 134 000
Remaining RES	55 960	1 659 000	2 286 000
Total CR	1 050 200	35 835 000	44 924 000

Expected additional costs to promote RES and combined production of electricity and heat (CHEP) and their impact to customers we can see on following graphs.

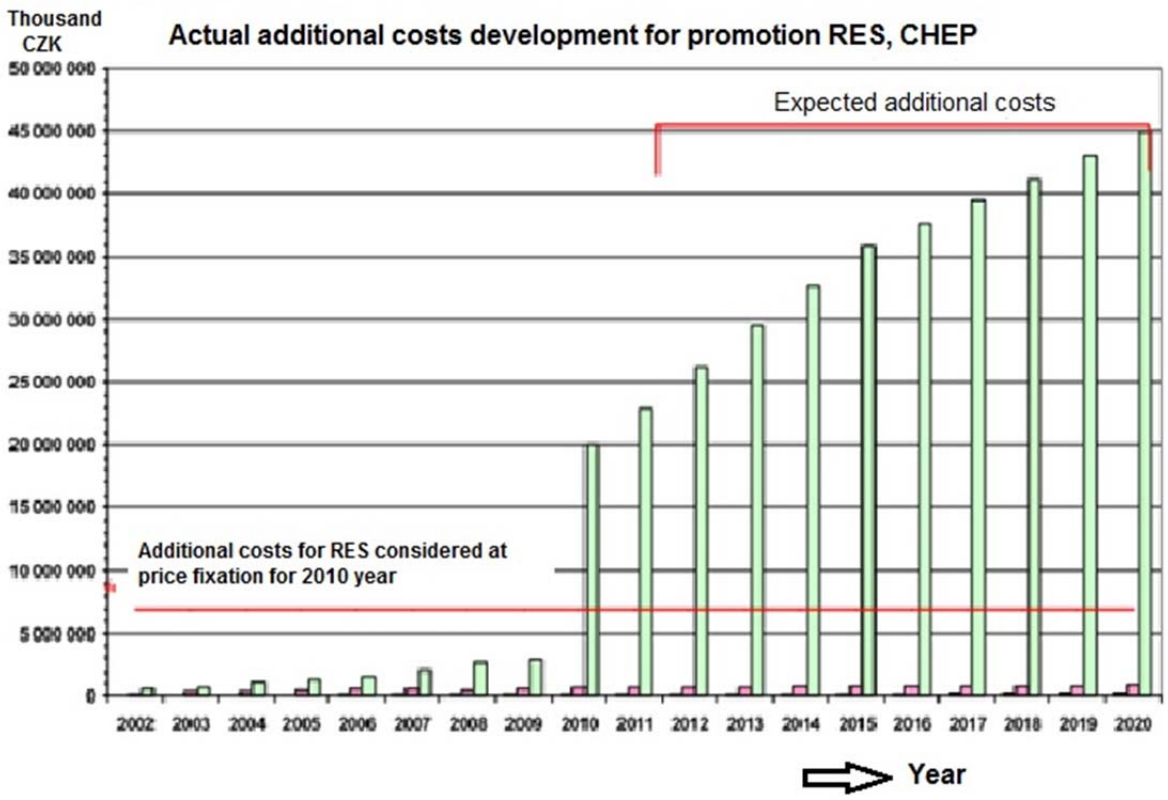

Figure 2 Actual additional costs development for promotion of RES and combined production of electricity and heat

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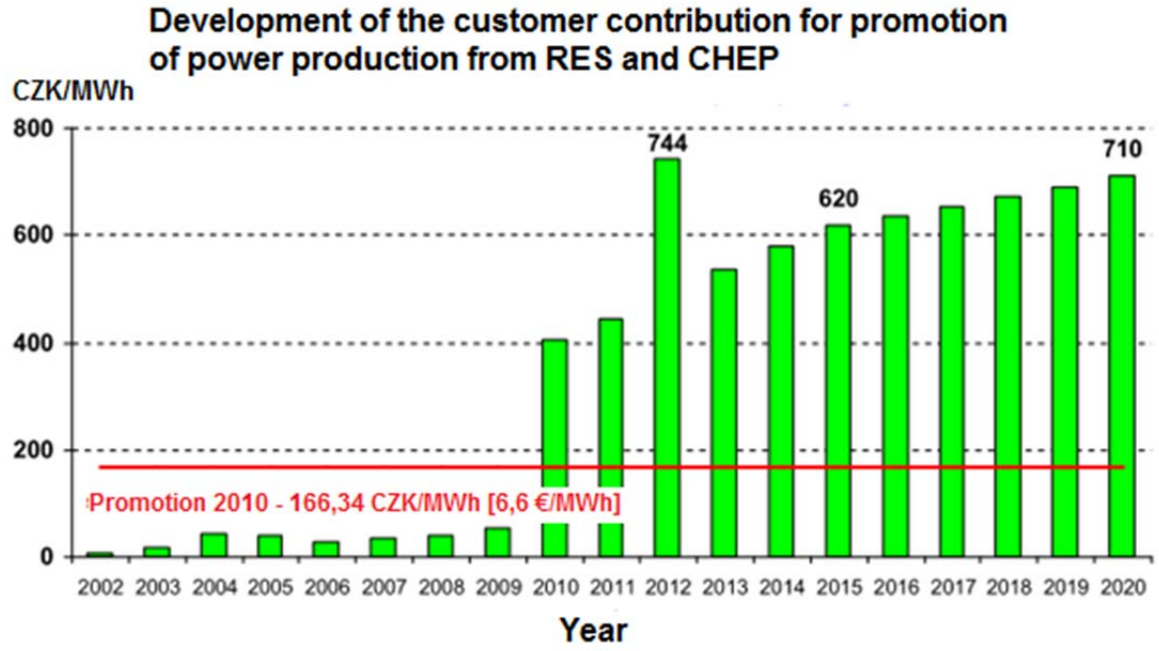

Figure 3 Development of the customer contribution for promotion of electricity production from RES and combined production of electricity and heat [1]

IMPACT OF CONNECTING RES TO NETWORK OPERATION

In 2010, an enormous increasing in connection requests of photovoltaic power plants to the distribution network was registered. The purchase prices of electricity from photovoltaic power stations were very high (about 50 cents/kWh). Investors from many countries were preparing the construction of new power plants. New photovoltaic power plants were connected to the distribution network of all voltage (LV, MV, HV). PVPP with installed capacity to 100 kW were connected to low voltage networks, with installed capacity to 10 MW to medium voltage networks, with installed capacity to 50 MW to high voltage networks [3,5].

Installed power of these power stations rapidly grows. In July 2010 has been issued stop for allowing new photovoltaic power plants. Previously accepted constructions have to be completed by the end of 2010. Only large projects were possible complete by end of February 2011 [4].

Installed power in low and medium voltage networks of was higher than distribution load. In many power transformers LV/MV and MV/HV the flow of power was reversed. Power production in photovoltaic power plants had influence to the transmission system.

In the following images we can compare the forecast and the real course of of photovoltaic power plants production in case of good prediction of the weather situation (Fig. 4, 5), and in case of a smaller production of photovoltaic power stations than were assumed (Fig. 6, 7).

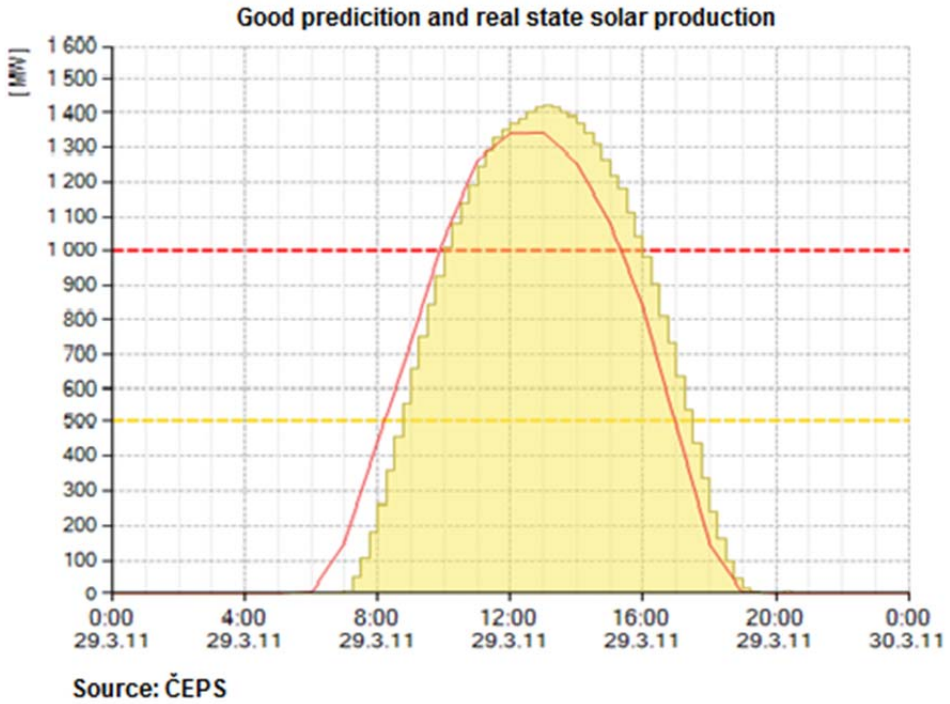

Figure 4 Real course of photovoltaic power plants production in case of good prediction of the weather situation

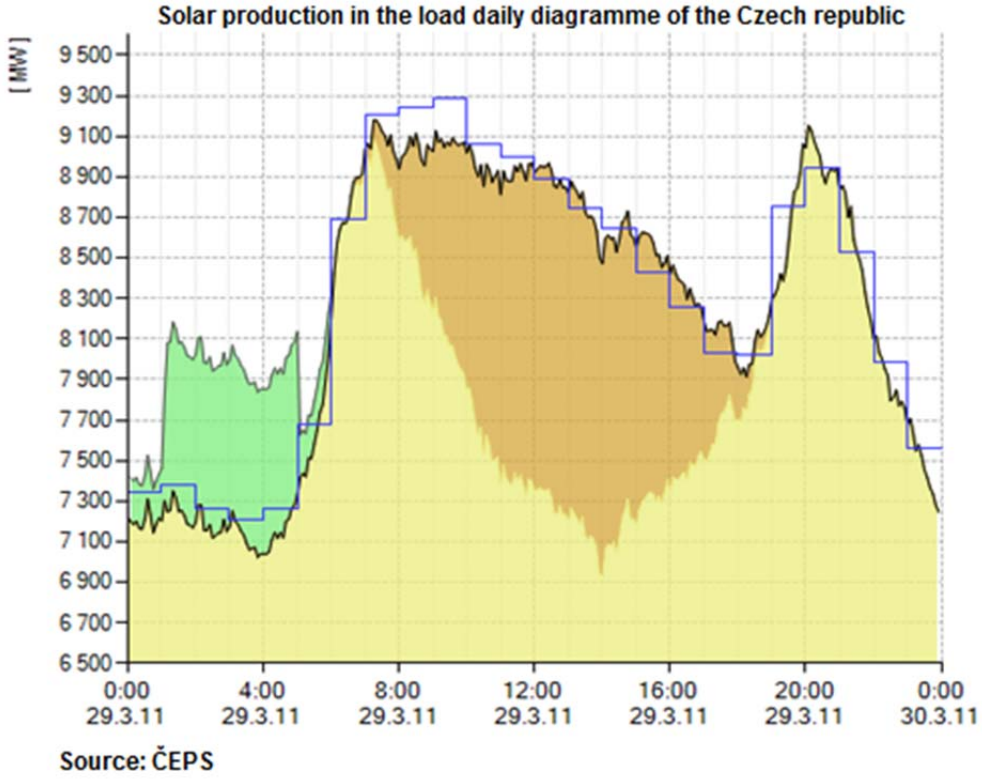

Figure 5 Solar production in the load daily curve of the Czech Republic

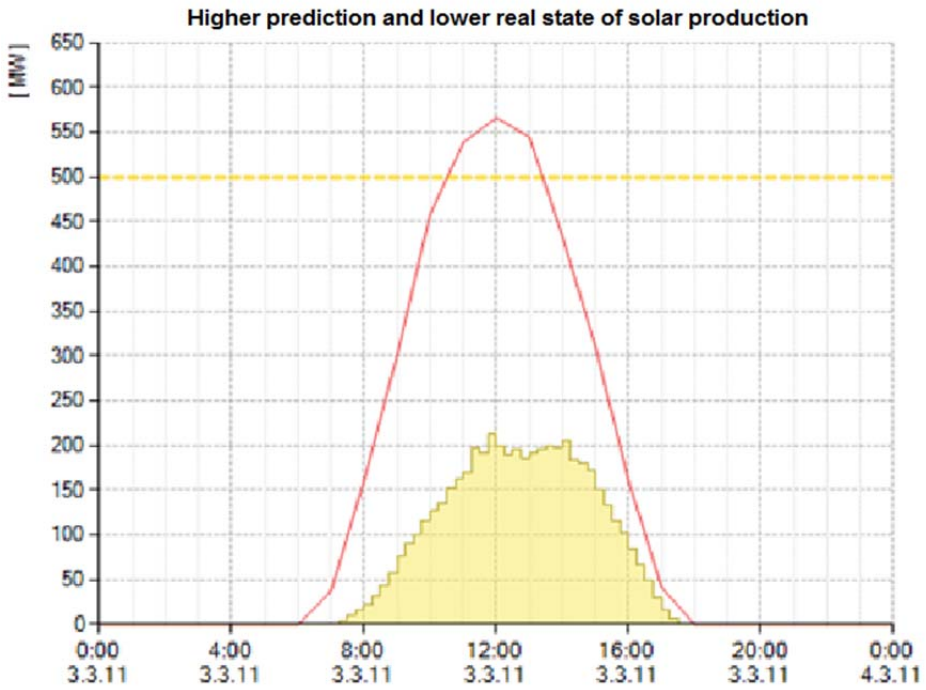

Figure 6 Higher prediction and lower real state of solar production

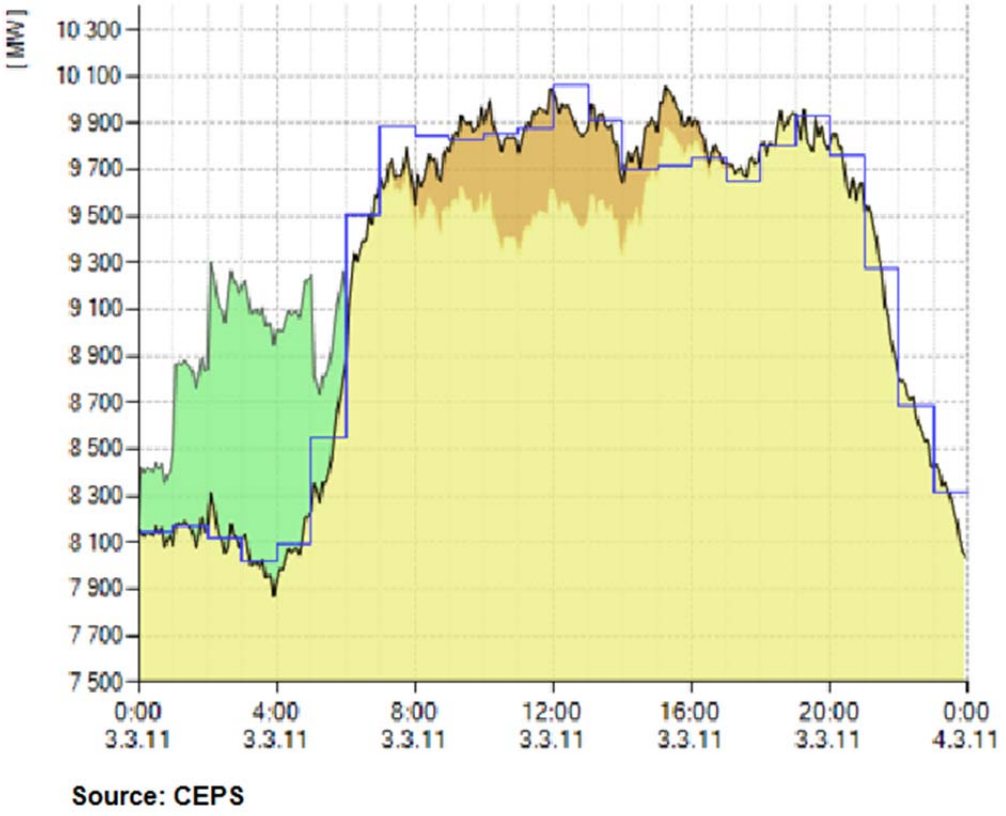

Figure 7 Solar production in the load daily curve of the Czech Republic

CONCLUSION

We will continue to promote the efficient development of electricity production from RES provided maintain safe and reliable operation of the power system of the CZECH REPUBLIC and the security of supply of electricity to customers

A positive handling of requests for connection PVPP and WPP is linked to the evaluation of the actual impact of electricity production from PVPP and WPP, which were now connected to distribution networks, the reliability and quality of power supply from the grid and their overall effect on the functioning of the power system, of the Czech Republic

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