Even despite such difference in efficiency, the cost of construction of planned wind farms in Serbia, per megawatt of installed capacity, is by more than 40 percent higher than the cost of construction of the new thermal power plant Kostolac B3. Today, the cost of a wind farm in Serbia is around 1.866 million euros per MW of installed capacity, whereas the costs of construction of the new thermal power station Kostolac B3 are only around 1.3 million euros per MW of installed capacity.

The estimates of Serbia's wind generation potential are exaggerated – because of incomplete measurement of wind speed or the data on the energy potential of wind at certain speeds is directly exaggerated.

The south-east part of Banat, which contains over 80 percent of Serbia's wind generation potential, does not in fact have favorable winds. In Plandište, for example, Košava, the most powerful domestic wind generation resource, blows for only 78 days a year on the average; in addition to košava, according to frequency, there are the winds from the southern quadrant over there –most often blowing in winter, for 61 days a year on the average. Košava is a seasonal, pulsating and cascade wind which changes the speed suddenly, blows in gusts of 2-3 days or 3-7 days on the average, with the mean speed of 5-11 m/s, with the maximum speed of up to 30 m/s (but at the speed of 25 m/s, wind generators must stop operating), with the highest blowing frequency in November and March; it reaches the largest strength in the area of Southeast Banat.

According to the research on the intensity of winds in Vojvodina – Study: Wind Atlas in AP Vojvodina – the mean annual speed of winds in Vojvodina at 50 meters above ground amounts to 3.5-4.5 m/s on the majority of territory; 4.5 m/s in the zone between B. Karlovac and Zrenjanin; and 5-6 m/s in the area around Vršac.

According to the data from the European Wind Atlas at the mean wind speed of 5.5 m/s at the height of 50 meters above ground, the energy potential, i.e. the wind power density, of only 200 W/m2 can be obtained – and not of 250 W/m2 as stated in this domestic study. In this way, the energy potential of wind with the speed of 5.5 m/s is increased by 25% more than the actually achievable.

The conclusion from this study: "With modern wind turbine technologies, which enable a profitable operation even at lower speeds, already above 3 m/s, it is possible to set higher capacities, therefore, it can be said that the potential is significant" – cannot be accepted. Unfortunately, it should be stated that there are no commercial wind turbines which can be profitable at the wind speeds of 3 m/s. It is simply about the energy potential of wind which is extremely low and economically inefficient at such low speeds – and there is no technology by which this wind energy per square meter of the rotor surface can be

increased.
Low wind turbines can possibly be profitable only at the wind speeds of over 6 m/s – and this under the condition of its prolonged activity during the year, i.e. in the case when its potential energy during the year is cumulatively higher than the energy that can be obtained from a faster wind of smaller duration on the same location.
According to international classification, the winds in Vojvodina mostly belong to the IEC class IV of winds, with the speeds below 6 m/sec and only to a small extent, at the height of 100 meters above ground, to the class IEC III of wind with the speeds of around 7.5 m/s
Subsidizing of Electricity from Wind Generators – Feed-in-Tariffs
The Serbian Government is not publishing the data on subsidizing the electricity from wind generators – which is achieved through guaranteed, significantly higher prices of its production. These guaranteed production/cost prices for the electricity form wind generators in Serbia, should be, according to certain publicly available data, by around 50% higher than the current sales prices of electricity for households.
Electricity production from wind generators is additionally subsidized in the world, through guaranteed purchase prices for a longer time period, which cover the costs of its production – which has not been the case with electricity production in Serbia so far.
According to certain data from 2009, Serbia has envisaged guaranteed purchase price of electricity from wind generators for a certain period in the fixed amount of 9.5 eurocents for one kilowatt-hour of supplied electricity.
Otherwise, today, the electricity price for households in Serbia amounts to somewhat more than 6 eurocents for one kilowatt-hour – which means that the production/cost price of electricity in our country is significantly lower.
The feed-in-tariffs, i.e. the guaranteed purchase prices of electricity from wind generators in Britain, which has the strongest winds in Europe, amount to around 10 eurocents for one kWh of supplied electricity, if it comes from a wind generator with the capacity over 500 kW, i.e. to around 18 eurocents for a kWh of electricity from the wind generators with the capacity below 500 kW.
Capacity Factor or Ratio between Actual Electricity Production and Installed Capacity of Wind Generator
In Serbia, there are manipulations in terms of equating the installed capacity of wind generators and the actually achievable, i.e. achieved electricity production.
According to European data from 2015, this ratio between the achieved electricity production and the installed capacity – the capacity factor – for the wind generators in Germany, amounts to only around 20 percent annually, whereas in the windy Britain, it

amounts to 25 percent; on two wind farms in the North Sea, the annual capacity factor of 50 percent has been achieved, but at mean wind speeds of 10 m/sec.
In other words, instead of the designated – installed capacity of a one-megawatt wind generator, for example, during the year, on the average, they actually generate only around 200 kWh of electricity per one hour of operation – i.e. the capacity factor of the wind generator amounts to only around 20 percent.
In Germany, which has stronger winds than the ones in Serbia, wind generators produce four times less electricity than the thermal power stations – measured per one megawatt of installed capacity – because the capacity factor of coal-fired thermal power stations is over 80 percent, whereas it is only around 20 percent for the wind generators on land. According to the data of the Fraunhofer Institute, in 2012, this capacity factor was only around 17.5 percent for German wind generators!
Even despite such difference in efficiency, the cost of construction of planned wind farms in Serbia, per megawatt of installed capacity, is by more than 40 percent higher than the cost of construction of the new thermal power plant Kostolac B3. Today, the cost of a wind farm in Serbia is around 1.866 million euros per MW of installed capacity, whereas the costs of construction of the new thermal power station Kostolac B3 are only around 1.3 million euros per MW of installed capacity.
Calculations for Electricity Production from Wind Generators
An economical electricity production from wind generators depends on several key factors: in addition to the size, i.e. the installed capacity of the wind generator, it depends on the wind speed at the height of the hub i.e. the rotor center, the duration of favorable wind activity during the year, and on the wind generation characteristics of the wind.
In general, there are two types of wind generators that are set to an installed capacity according to various average wind speeds:
– Standard type – IEC class I and IEC class II – for the 1st and the 2nd class of wind with the speeds of 10 m/s and 8.5 m/s, in which wind turbines start operating only at the speeds of 3.5-4.5 m/s and they reach their full, installed capacity at the wind speeds of 12-17 m/s; large commercial wind turbines usually reach their installed capacity at the wind speeds of 12-14 m/s and they maintain the same level of production by pitching the wind turbine blades according to the direction of wind activity. At wind speeds of more than 25 m/s – the wind generator completely stops operating.
– Low-wind turbines, for areas with lower wind, are designed to operate at the class 3 wind of around 7.5 m/s, up to somewhat more than 6 m/s – but provided that the wind which is used is not intermittent and cascade, and that its activity takes place over a longer time

period during the year.
Otherwise, such wind turbines have higher-diameter rotors and lower-capacity generators with respect to the standard wind turbines, their installed capacity is lower and it is reached at the average wind speed of 7.5 m/s to somewhat above 6 m/s. They generate less electricity per unit area of rotor surface but they operate within a longer period during the year, and thereby, on certain locations, they can cumulatively produce more electricity than if they were set to a shorter period of high speed wind activity.
The height of wind turbine towers, i.e. height of the hub above the ground, also affects electricity production, because the wind speed increases at bigger heights – and, therefore, the amount of generated electricity. By increasing the height of rotor, the price of the wind turbine tower itself also increases so a previous cost-benefit analysis is necessary.
For low-wind turbines of the class IEC III, a somewhat bigger tower height is recommended: 90-140 meters of the tower height for the wind turbines with the capacity of 1.5-3 MW, with rotors the diameter of which is 82-125 meters.
Due to the low average wind speed in Serbia, it would be necessary to increase the height of wind turbine towers to 100 meters and more, which increases their price. It can happen that even this would not be enough for a profitable operation of wind generators in our country in case that there are no average wind speeds over 6 m/s within a longer period of the year.
In the formula for calculating the electricity produced from wind generators, the wind speed participates raised to the third power, so the amount of electricity generated in standard wind turbines at the speed of 3.5 m/s is in fact 40 times smaller, and, at the speed of 4.5 m/s, it is 20 times smaller than the amount of electricity produced at the wind speed of 12 m/s; at the wind speed of 5.5 m/s, 10 times less electricity is produced, and at the wind speed of 6 m/s, eight times less electricity is produced than at the speed of 12 m/s – which determines the nominal capacity of standard wind turbines.
Obligations of Serbia towards EU or Cost of Wrong Choice
Foreign companies are pressuring the Serbian Government to issue permits for the construction of wind farms – with previous guarantees for purchasing electricity from them – but they do not mention publicly that these guarantees also include a certain level of state subsidies, i.e. the guaranteed purchase prices for the electricity from wind generators – which are significantly higher than today’s electricity sales prices in Serbia.
The information regarding the necessary and reasonable construction of facilities for producing renewable energy in Serbia, as well as the efficiency of such facilities in our country – particularly wind generators – are mostly wrong and based on incomplete or even false data:

– The European Union has adopted a binding decision for its members to achieve 20 percent of renewable energy in their energy mix by 2020 – and Serbia, on its own, has made the decision to build the facilities for producing 27 percent of renewable energy by this deadline, although already today, it generates more than 21 percent of such energy.
Today, such unnecessarily high level of renewable energy in Serbia, which has been declared as an obligation of Serbia towards the EU, has become the basis for the entry of unfavorable foreign investments in the construction of inefficient energy facilities – small hydro power stations and wind generators – which will affect the increase in the electricity price in Serbia.
Domestic media, unfortunately, have put themselves in function of deceiving the citizens about the profitability of construction of wind generators in Serbia. Without checking, they publish the data about the operation of wind generators obtained from the foreigners – who, above all, are interested in selling their wind generators in our country.
The sales of wind generators in Europe have been in decline and the plans for their production by 2020 have been reduced by 20 percent, whereas in the USA, their sales have been stagnating for several years already.
It seems that the experts from the Serbian Ministry of Energy have also uncritically accepted the information on the side about the efficiency of wind generators.
The data on the construction of wind generators in Serbia, as well as on the construction of small hydro power plants, are in fact covered by a certain veil of secrecy, with a little bit of incomplete or inaccurate news in domestic media– which will bring the citizens, as well as the Serbian energy sector, in an even worse position.