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Impact of wood biomass market development on firewood price in Serbia

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DKTI- Development of a Sustainable Bioenergy Market in Serbia

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Introduction

Although wood is used as energy source for thousands of years, it has recently gained new attention. High dependency on energy imports and the effects of climate change are challenging modern economies and societies. Wood energy came back in the focus of policy-makers as a renewable energy source to tackle these issues. For instance, the European Union has set policy targets for renewable energy, and these targets can be expected to have major implications for the forest sector.

The potential of biomass as a renewable and locally produced energy source is recognized also in Serbia. The Strategy of energetic development of the Republic of Serbia until 2025 set target of 27% of renewable energy sources -RES in gross final energy consumption by 2020. Among all renewable energy sources, wood biomass has the highest potential in Serbia. More and more municipal authorities are making plans to use wood for district heating.

Even now, with low fossil fuels prices, wood is proven to be cheaper energy source than oil, oil derivatives or natural gas. With expected increase in fossil fuels prices, the demand for wood as an energy source will increase significantly, which will drive the competition for this desirable raw material among its energy use and material use (such as construction material, composite wood products or paper production input). Government subsidies aimed at promoting the use of wood as a sustainable fuel contributes to rising competition.

The increased competition for the wood, between different forms of its usage (as energy source and as a material), as well as the increasing competition for energy wood among consumers (households, industry, energy sector) is rising the question of its further price development. Substantial increase in wood price would significantly undermine economical basis of its usage as an energy source. Also, increased price of wood could have significant social impact in developing countries (as in Serbia), as the firewood is the major heating fuel among the economically vulnerable groups.

The use of firewood in Serbia has a highly expressed social component because it is the only available energy-generating product for a large part of the population. Redirection of firewood market from present consumers to another consumption type (district heating systems, pellets, wood panels, etc.) could lead either to social problems (because of the reduction of firewood supply for population) or to increased scope of forest use (over the allowed limits), namely social and economic component of forest management would be significantly jeopardized (Vasiljevic, A., 2015).

The objective of this study is to estimate the potential impact of the rising usage of wood as a fuel in district heating and CHP plants in Serbia on firewood price.

Methodology

Prices of wood products, as of any other goods or services, are determined by demand and supply. Prices adjust to bring demand and supply into balance. Movements in wood product prices have both a long-term and a short-term element. The long-term path is related to long-term trends in demand and supply. In the shorter term, price movements can result from temporary shocks to supply and/or demand conditions. One challenge is to identify what element of a change in prices is part of the long-term pattern, and which part is a short-term change.

In the long term, the change in demand for wood products is related to economic growth – which is largely determined by population growth, capital investment, and technological progress. In energy sector, wood competes with alternative fuels, which is why and relative prices, changes in tastes and preferences, and policy measures are important in determining demand.

On the other hand, wood supply is determined by management of forest resources. Forecasts for developments in the forest resource are based both on factors that are relatively fixed, and factors that are more variable. The former include growing stock, growth rates, age classes, and site productivity. The latter include regeneration methods and spacing of planting. Given the availability of timber resources, current levels of round wood supply depend on decisions about when to harvest. These decisions are influenced by issues that include: levels of market demand, expectations regarding present and perceived future prices for round wood and harvesting costs, as well as a diversity of forest management objectives (Forestry Group, 2004).

In order to estimate future trends in energy wood demand and supply, the starting point in this study will be the outlook of current energy wood balance of the republic of Serbia, national renewable energy sources plan and estimates of wood biomass potential. Based on that, the alternative scenarios regarding future trends in wood fuels supply and demand will be determined. If demand is going to increase at a rate higher than in case of supply, the upward pressure on wood prices would emerge, and vice versa.

Beyond estimations of future development of wood biomass supply and demand, the relationships between different fuels prices, as well as between wood fuels prices and growing energy production by wood biomass combustion are going to be investigated by econometric method (Johansen cointegration test) applied on data from several countries.

Econometric model's results, as well as estimated further development of wood biomass demand and supply in Serbia, would provide us a solid ground for making estimations of future development of firewood price in Serbia.

Determinants of wood price

Wood energy markets are inherently complex phenomena and hence wood energy prices are a function of many different variables (Olsson, et al., 2010). However, three factors were identified as the most important: biomass demand, production costs, and type of feedstock.

The relationship between wood biomass demand and its price is straightforward: if demand exceeds supply, the price is going up, and vice versa. The expansion of installed capacities in both DHP and CHP plants that use wood biomass could lead to a strong increase in wood fuel demand. However, even if the demand for wood fuels increase, the price is not going to follow that pattern if the production costs are not increasing, too. A manifestation of this has been observed in e.g. Sweden when during the 1990's, in spite of increasing demand for wood fuels, the price of the wood fuels stayed relatively constant due to a stable supply of residues from the forestry sector (Hillring, 1999).

The cost of producing wood fuel is, thus, an important factor deciding the price at which the fuel will be sold. As production of wood fuels is very labor intensive, the price of wood energy primarily depends on the price of labor. Hence, during time periods of rapid wage increases, wood fuel production costs increase and in turn wood fuel prices have increased. The link between labor costs and wood fuels price is less significant nowadays, as wood fuels production processes are more and more mechanized.

Price can also vary depending on the biomass feedstock - a study by Hedman (1992) analyzing the Swedish wood chip market reveals that the main price determinant for wood chips produced out of cutting residues (e.g. branches, wood from thinning, low quality stem wood) is the cost of production, whereas sawmill residue price was more dependent on the willingness to pay on the part of competing demand industries, e.g. particle board industry. As to wood pellets and briquettes, cost of production was said to be the main price driver, though the price level of heating oil was denoted as a natural 'price ceiling' (Olsson, et al., 2010).

Interesting issue in the relevant literature is the relationship between fossil fuels and wood fuels prices. The link between fossil fuel prices and biomass prices is not straight-forward. Changes in the price of oil have impacts on wood fuel prices on several levels. First, since petroleum products such as diesel and petrol are used in the process of producing wood fuels, increases in oil prices will push production costs upwards. However, these costs are in general very small and do not have a significant impact on the development of wood fuels.

Another connection between the price of oil and the price of wood fuels lies in the substitutability between the types of fuel. Higher oil prices increase the demand for

alternatives such as wood energy which in turn will increase wood fuel prices. However, results of different studies are not straightforward.

Wood energy in Serbia

Primary energy production in Serbia in 2015 is estimated at 454,789 TJ, with fossil fuels share of 81% and renewable share of 19%. Within energy production from renewable energy sources of 85,498 TJ, the share of wood fuels is 54%, i.e. 46,140 TJ, making the wood fuels the far biggest renewable energy source in Serbia.

In gross inland energy consumption of total 630,290 TJ in 2015, fossil fuels share is 87%, while renewable share is 13%. Out of 83,301 TJ of renewable energy consumption, 43,943 TJ, i.e. 53%, is from wood fuels.

While Serbia has an overall trade deficit in energy in 2015 (estimated at 178,359 TJ), the surplus was achieved in wood fuels (2,417 TJ), indicating a high potential in wood fuels production.

Table 1. Wood fuels in Serbian national energy production and consumption in 2015

	Total	Fossil fuels (natural gas, oil and oil products, coal and coal products)		Renewable energy sources (solar, hydro, geothermal, biogas, wood fuels)		Wood Fuels		
	TJ	TJ	% of total	TJ	% of total	TJ	% of total	% of RES
Primary production	454,789	369,291	81%	85,498	19%	46,140	10%	54%
Import	240,022	216,934	90%	396	-	396	-	-
Export	61,663	32,855	53%	2,813	5%	2,813	5%	-
Stock changes	1,836	13,046	711%	220	12%	220	12%	100%
Gross inland consumption	630,290	550,292	87%	83,301	13%	43,943	7%	53%

Source: Statistical Office of the Republic of Serbia

Final energy consumption in Serbia in 2015 is estimated at 341,689 TJ. The share of fossil fuels is 50%, 13% of renewable energy sources, 29% of electricity and 8% of heat. Almost total final energy consumption of renewable energy sources are the consumption of wood fuels (99.5%).

Wood fuels consumption in Serbia in 2015 is estimated at 43,237 TJ. Out of it, 82%, i.e. 35,480 TJ is consumed by households. Wood fuels consumption has a share of 30% in total energy consumption in households, making it the second most important energy source in

Serbian households after electricity (42%). Wood fuels also have a share of 6% in industry energy consumption, and 2% in consumption in agriculture.

Table 2. Wood fuels in final energy consumption in Serbia in 2015, by sectors

	Total		Fossil fuels		Renewable energy sources		Wood Fuels			Electricity		Heat	
	TJ	% of total	TJ	% of total	TJ	% of total	TJ	% of total	% of RES	TJ	% of total	TJ	% of total
Final Energy consumption	341,689		170,644	50%	43,595	13%	43,237	13%	99%	97,462	29%	29,988	8%
Industry	89,284		48,135	54%	5,588	6%	5,569	6%	100%	25,578	29%	9,983	11%
Construction	2,254		1,109	49%	-	-	-	-		1,145	51%	-	-
Transport	85,273		84,011	99%	-	-	-	-		1,262	1%	-	-
Households	121,216		18,299	15%	35,480	29%	35,480	29%	100%	50,624	42%	16,813	14%
Agriculture	6,525		5,091	78%	294	5%	107	2%	36%	1,140	17%	-	-
Other users	37,137		13,999	38%	2,233	6%	2,081	6%	93%	17,713	48%	3,192	9%

Source: Statistical Office of the Republic of Serbia

While it could be stated that wood fuels with share of 10% in primary energy production and 7% in final energy consumption have a significant position in Serbian energy balance, comparable with a lot of EU countries, the structure of wood fuels consumption provides as a picture significantly different than in developed EU countries. Compared to developed North and Central Europe, firewood has a much bigger share in total wood fuels production and consumption in Serbia, while the shares of wood chips, briquettes and pellets in Serbia are totally negligible and, thus, much lower than in these countries. The explanation for this disproportion lies in difference in sectoral consumption of wood fuels. From several decades ago, developed Northern and Central European countries encourage and stimulate the use of wood fuels in district heating and CHP plants. On the other hand, wood is almost not used as a fuel in DHPs and CHPs in Serbia (with few exemptions only). Over 99.5% of total wood fuels consumption in Serbia is firewood, consumed mostly by households for heating purposes.

Table 3. Wood fuels balance in Serbia in 2015

	Total	Firewood	Wood residue and Wood chips	Wood briquettes	Wood pellets	Charcoal
	TJ	TJ	TJ	TJ	TJ	TJ
Primary production	46140	45827	313	–	–	–
Import	396	202	–	19	130	45
Export	2813	800	–	144	1550	319
Stock changes	220	24	–	33	203	8
Gross inland consumption	43943	45205	313	92	1217	266
Transformation input	3014	2651	313	13	37	
Transformation output	2330	–	–	152	1809	369
Final Energy consumption	43237	42534	–	47	554	102
Industry	5569	5183	–	36	265	85
Construction	–	–	–	–	–	–
Transport	–	–	–	–	–	–
Households	35480	35217	–	11	242	10
Agriculture	107	107	–	–	–	
Other users	2081	2027	–	0	47	7

Source: Statistical Office of the Republic of Serbia

According to presented balances, total wood fuel production in Serbia in 2015 was 3,670,831 tons of wood, of which firewood was 3,646,198 tons. Serbia has a long tradition of firewood usage for heating and cooking. Firewood is still the most widespread energy resource for households. Even now, forests in private ownership are mostly used for heating and food preparation. Many studies on firewood consumption point at the fact that actual firewood consumption is much higher than the officially registered. Different studies have estimated the consumption of firewood from forests to be 6 to 9 million m³, thus 2 to 3 times higher than officially recorded in 2015.

Also, use of wood as energy resource in households is extremely irrational due to the use of outdated and inadequate stoves. This leads to an obvious conclusion that with the increase of efficiency degree of firewood use significant amounts could be released which would contribute to the increase of modern biomass production. Practically, transfer from traditional to modern way of biomass use can create space for the substitution of other energy-generating products without increasing cuts (Vasiljevic, A., 2015).

Wood biomass in electricity and heating energy production in Serbia

As the objective of the study is to estimate the effects of fuel switch from fossil fuels to wood biomass in DHPs and CHPs in Serbia on the price of firewood, first step should be the estimation of current and future utilization of wood biomass in heating energy and electricity production in Serbia.

Currently there are no CHPs in Serbia. Milan-based company “Building Energy” is to build a first-of-its-kind combined heat and power biomass plant in Kruševac. On the other hand, there are 52 district heating plants. Their annual heat energy production is estimated at 6,281 GWh, while their energy input is estimated at 7,420 GWh (Table 4). Natural gas has the far biggest share in energy production in Serbian DHPs (74%), while HFO has a share of 16% and coal almost 10%. Biomass has almost negligible share of 0.2%.

Table 4. Fuels consumption in DHPs in Serbia

fuel unit	coal tons	gas m ³	HFO tons	other tons
Consumption in units	221,600	546,473	109,530	3,170
Consumption in MWh	709,120	5,464,728	1,227,466	18,473
Shares in consumption (in %)	9.6	73.7	16.5	0.2

Wood fuels in Serbian national energy strategies

According to National renewable energy action plan of the Republic of Serbia, the Republic of Serbia should increase the share of renewable energy sources (RES) in gross final energy consumption (GFEC) to 27.0 % until 2020 (this target is taken from relevant EU regulations). As GFEC in Serbia in 2020 is estimated at 9,495 ktoe, the quantity of RES should amount to 2,564 ktoe in 2020. This means that additional 600 ktoe of RES in annual energy consumption should be achieved compared to 2015.

The technically usable potential of renewable energy sources in Serbia is estimated at 5.6 Mtoe per year. This means that RES could have a considerable contribution to a lesser utilization of fossil fuels and achievement of defined targets regarding the share of renewable sources in the GFEC, as well as regarding the improvement of environment. Out of total RES potential, the biomass has potential of approximately 3.4 Mtoe per year (2.3 Mtoe per year is unused, and 1.1 Mtoe is used). About 50% of biomass potential refers to wood biomass.

The share of RES in the electricity sector in 2020 will amount to 36.6 %, in the heating and cooling sector it will amount to 30 % and in the transport sector to 10 %. All these individual targets will enable meeting of the joint target of 27 % in GFEC in 2020 (heat from RES will contribute to the target achievement with 12.3%, electricity from RES will contribute with 12.1% and the biofuels with 2.6%).

To achieve its targets in the electric power sector, the Republic of Serbia plans to install additional 1,092 MW until 2020, with the share of biomass of 17.5% (biomass CHP plants, 55 ktoe).

To achieve its targets in the sector of heating and cooling, besides the use of biomass for heating in individual households, until 2020 the Republic of Serbia will also use RES which have not been used so far. It is planned that the target in this sector is achieved with additional 149 ktoe. Out of it, 124 ktoe (83%) should be generated from wood and agricultural biomass (while another 25 ktoe should be produced from other renewable energy sources). Out of these 124 ktoe, it is estimated that additional 25 ktoe of heating energy production in DHPs will be based on biomass usage, additional 49 ktoe would be

produced in CHPs by biomass combustion, and 50 ktoe would be produced in individual households.

With assumed share of wood biomass of 50% in total biomass for electricity and heating production in CHPs and DHPs, it is possible to calculate that additional 114.5 ktoe of additional energy per annum should be produced from wood biomass until 2020 (27.5 ktoe of electricity in CHPs, 24.5 ktoe of heating energy in CHPs, 12.5 ktoe of heating energy in DHPs and 50 ktoe of heating energy in individual households). Even these 114.5 ktoe are far lower than estimated technical potential of 1,150 ktoe of unused wood biomass. As about 1,100 ktoe of energy was produced from wood biomass in 2015, additional 114.5 ktoe represent an increase of 10.5%.

Forecast on wood fuels demand

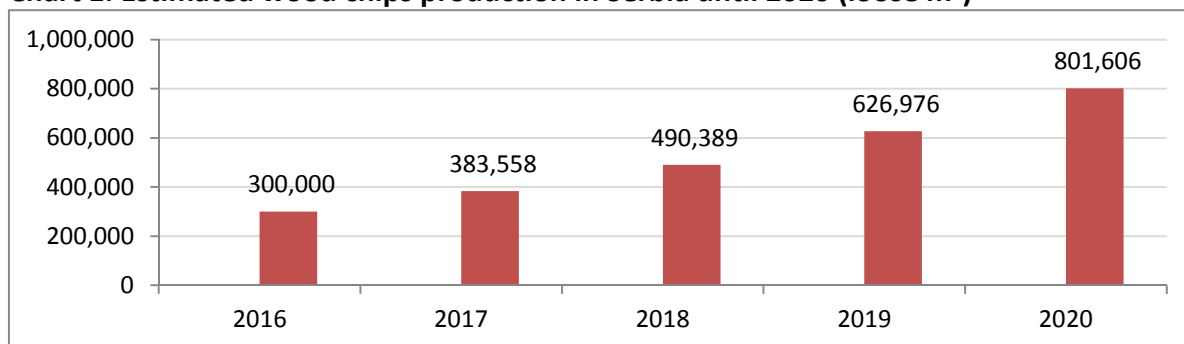
To achieve national renewable energy targets in the sector of heating and cooling until 2020, the Republic of Serbia should use far more biomass than now. It is planned that the target in this sector is achieved with additional 149 ktoe, of which 74 ktoe should be produced from wood and agricultural biomass in DHPs and CHPs, and new 50 ktoe of heating energy should be produced by biomass in individual households (the rest of 25 ktoe should be produced from other renewable energy sources, as solar, biogas, etc.).

If the share of wood in total biomass that could be used as fuel in DHPs and CHPs is assumed to be 50%, it means that additional 37 ktoe, should be produced from wood biomass in DHPs and CHPs (12.5 ktoe in DHPs, 24.5 ktoe in CHPs). As current heat production in DHPs from wood biomass is almost negligible, this means that almost all of that amount of heat energy should be produced annually in DHPs and CHPs in Serbia until 2020. It is equal to 7% of total energy output of all DHPs in Serbia in 2015.

In order to produce 37 ktoe of energy, DHPs and CHPs should burn approximately 44 ktoe of wood biomass. With assumed net heating value of wood biomass of 12.5 MJ/kg, it means that 123,251 tons of wood biomass would be needed. This is equivalent to 200,642 solid m³ of wood, i.e. 501,606 loose m³ of wood chips.

As current wood chips production in Serbia is estimated at 300,000 loose m³, with additional 501,606 loose m³ of wood chips, the total wood chips production in Serbia in 2020 would be approximately 801,606 loose m³. This would be achieved with 27% of annual increase rate in production of wood chips. Chart 1 presents the estimated wood chips production in Serbia until 2020 (achievement of national goals of the share of renewable in energy production is a presumption).

Chart 1. Estimated wood chips production in Serbia until 2020 (loose m³)



Source: Author's calculation

To achieve defined targets in National RES energy plan, the wood chips production in Serbia in next 4 years should be 2.6 times higher than in 2015. However, as total wood fuel

production in Serbia in 2015 is estimated at 3,670,831 tons, additional 123,251 tons of wood biomass represents the increase in production of only 3.3%.

Two main conclusions could be made:

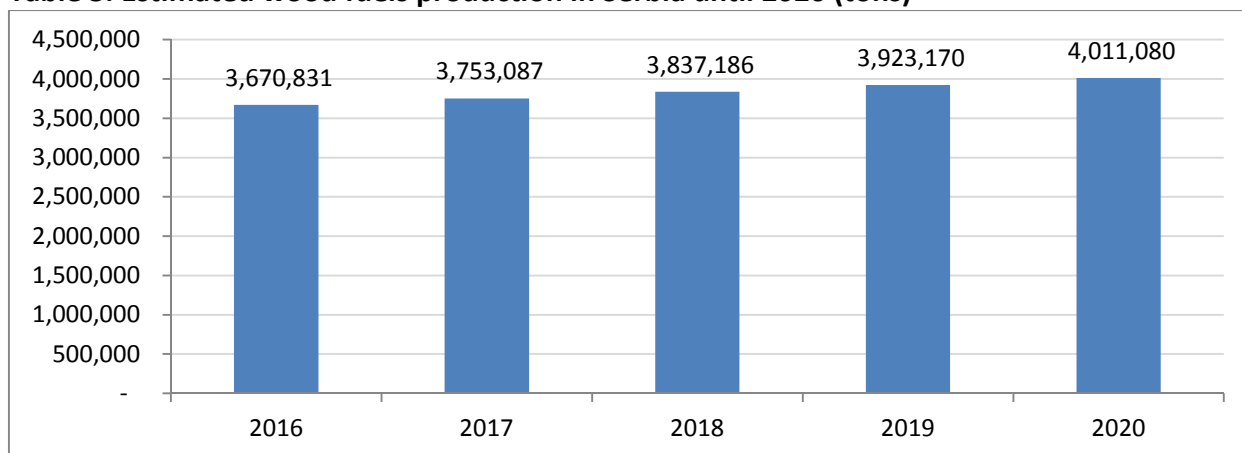
- 1. Fuel switch from fossil fuels to biomass in Serbian DHPs (and establishing of new biomass-fueled CHPs) in order to meet national RES targets until 2020 would require the increase of the wood chips production of 27% annually until 2020, which presents the huge growth potential for wood processing industry in Serbia;*
- 2. Fuel switch from fossil fuels to biomass in Serbian DHPs (and establishing of new biomass-fueled CHPs) in order to meet national RES targets until 2020 would require the increase of wood fuels production of only 3.3% compared to 2015.*

The growing demand for wood fuels in Serbia is not going to be the result of fuel switch to biomass in DHPs and CHPs only. National RES energy action plan assume that the set targets will be meet only if additional 50 ktoe of heating energy would be produced from biomass in individual households.

The share of firewood in households' heating energy production from biomass is assumed to be 95%. It means that additional 47.5 ktoe of heating energy annually should be produced from firewood in 2020. This could be achieved with the combustion of 65 ktoe of wood, i.e. 217,000 tons of wood. This represents the 6% increase in wood fuels production (and firewood production) compared to 2015.

If all aspects of increased wood fuels utilization according to the national RES energy action plan are considered (increased heat production in DHPs, increased heat production in individual households, and increased electricity and heat production in CHPs) the wood fuels demand would increase for additional 340,251 tons in 2020 compared to 2015, which is an increase in wood fuels production of 9.3%. Table 5 presents the estimated demand of wood fuels in Serbia until 2020 (growth rate of approximately 2.2% per year).

Table 5. Estimated wood fuels production in Serbia until 2020 (tons)



Source: Author's calculation

Compared to available wood biomass potential in Serbia, this growing demand for wood fuels should not lead to significant pressure on wood prices in Serbia. However, the plan to achieve this in the short run (in only 4 years) without market disturbances can be disputable. Rapid increase in wood demand could produce a pressure in wood fuels market. If the increase in the supply could not follow the same speed, the price will go up. Experience from some regional countries could be useful.

The renewable energy sources energy consumption in heating has been growing virtually in all EU countries, including countries from region, such as Slovenia, Croatia and Romania. In the period from 2004 to 2013, the RES energy consumption in heating and cooling has increased for 75 ktoe in Croatia, 445 ktoe in Romania, and 145 ktoe in Slovenia (Eurostat, 2015). Average annual growth rate in RES energy consumption in heating was 2% in Croatia, 1.5% in Romania, and 3.3% in Slovenia. In scenario of achievement of strategy plan in Serbia, the estimated annual growth rate in the period from 2016 to 2020 should be 3.5%. With appropriate strategy and governmental support, this rate should not lead to market disturbances. To provide solid argument for this statement, the case of Austria should be mentioned.

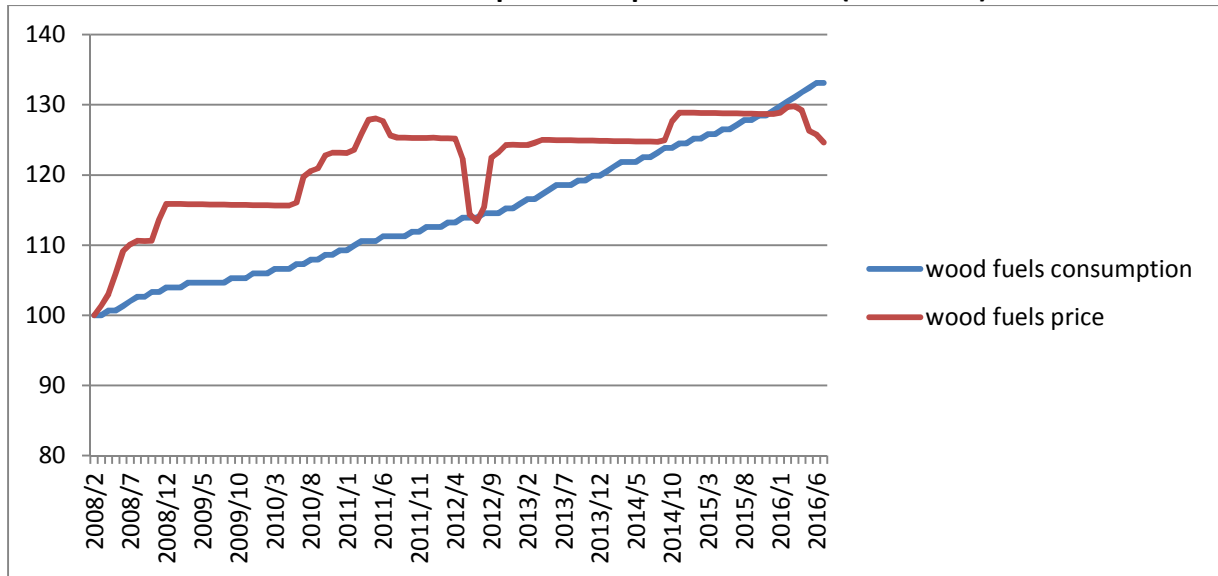
Case study: Wood fuel price development in Austria

In the mid-1980s, local biomass heating networks began to be developed and constructed in rural areas of Austria. Since then, this market has experienced a considerable upturn. Although fossil fuels are still the predominant source of energy for heating dwellings in Austria, renewable are gaining on importance, and they were covering about 23% of the heating demand in Austria in 2013 (Statistik Austria, 2013). The consumption of final energy from wood fuels increased in Austria from 142 PJ in 2007 to 179 PJ in 2013.

The rapid expansion of installed capacities in both DHP and CHP plants in Austria led to a strong increase in wood fuel demand. For instance, wood fuels demand increased from 2.0 million solid m³ in 2004 to 5.1 million solid m³ in 2007 i.e. more than doubled in just 3 years. Despite that, the growth in wood prices was relatively small. Such disproportion in the experienced rise of wood demand and wood prices in Austria could be explained with the active role of Austrian government and its proactive approach. Federal Ministry of Agriculture, Forestry, Environment and Water Management has commissioned the Austrian Energy Agency with the project to help mobilize the unused timber resources existing in Austria's forests and to accelerate the introduction of new quantities of energy wood into the market. A lot of such programmes were introduced both on national and regional and local level in Austria. As a result, wood fuels supply increased and its prices grew at lower rate than wood fuels demand through years. It is important to conclude here that policy measures of different kinds are the important price driver for wood fuels, as well as most other forms of renewable energy.

Chart 2 shows the development of wood fuel consumption and price (in average of wood chips and firewood) in Austria from 2008 to 2016. The wood fuels price has increased in the period from 2008 to 2016 for 25%, while the wood fuel consumption has increased for 33%. In order to explore the relationship between consumption and prices, the Johansen cointegration test was conducted on these two time series. The results do not confirm the existence of cointegration, meaning that there is not long run co-movement between wood fuel price and consumption in Austria in selected period. This suggests that growing demand of wood fuels in Austria due to the increase in biomass-based production of heat and electricity was followed by the increasing supply. As a result, the consumption and price of wood fuels were not moving together. The same was observed in Sweden during the 1990's, when in spite of increasing demand for wood fuels, the price of the wood fuels stayed relatively constant due to a stable supply of residues from the forestry sector (Hillring, 1999). Here, the role of the government can be crucial. If the increase in the demand is rapid, financial and fiscal stimulus should be provided in order to support the increase in wood fuels supply at the same pace.

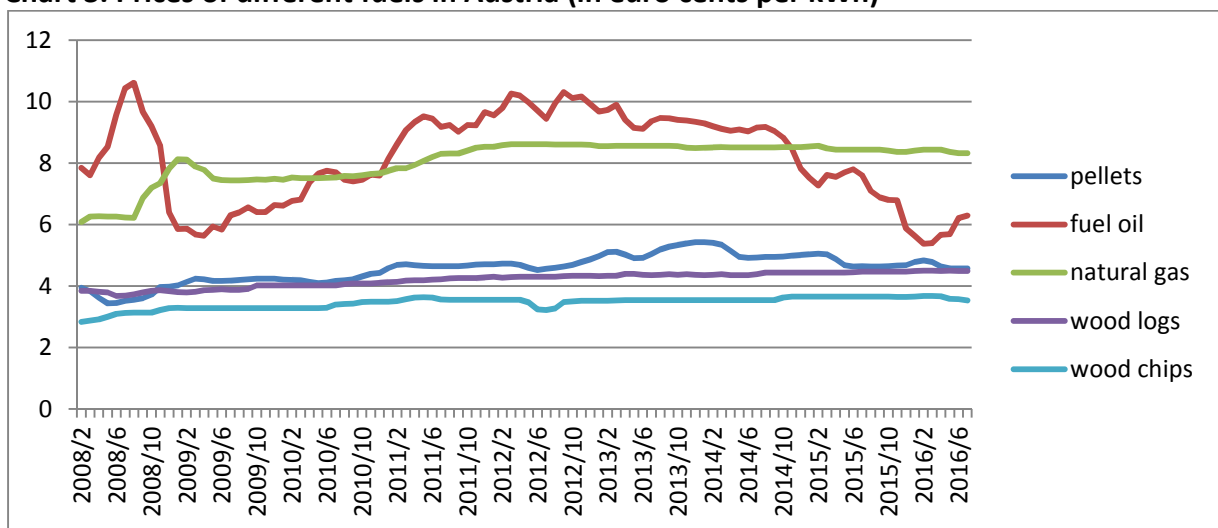
Chart 2. Indices of wood fuel consumption and price in Austria (2008=100)



Source: Statistik Austria for wood fuels consumption; Austrian Biomass Association for wood fuels prices

Chart 3 shows the price movements for different fuels in Austria from 2008 to 2016.

Chart 3. Prices of different fuels in Austria (in euro cents per kWh)



Source: Austrian Biomass Association

Two main conclusions can be made at the first glance on Chart 3:

1. *The price of wood fuels are constantly lower than price of fissile fuels, even during the period of historically low price of oil on the global market;*
2. *The volatility of wood fuels prices are much lower than the volatility of fossil fuels. Price stability is observed as a significant advantage of renewable energy sources compared to fossil fuels.*

In order to exploit the relationship between the price movements of different fuels in Austria, the Johansen cointegration test was performed. Table 6 presents the results. Co-movement in prices was observed between two pairs: fuel oil and natural gas, and wood logs and wood chips. While it is reasonable to expect the prices of the same type (fossil or wood) to move together in the long run, relationship between fossil fuels prices and wood fuels prices were not found in this sample, even though these two types of fuels could be observed as substitutes. The explanation could be the relatively short period of observation (9 years), as once installed capacities in DHPs and CHPs could not be changed in short run.

Table 6. Cointegration among different fuel prices in Austria (2008-2016)

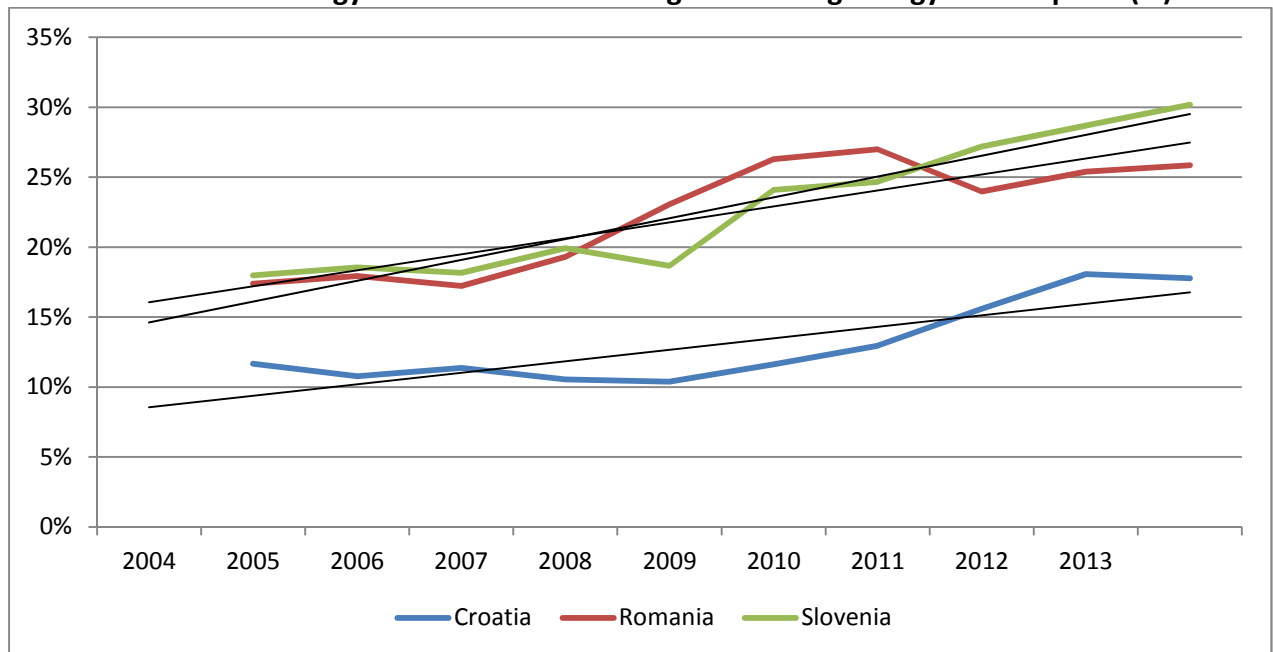
	Fuel oil	Natural gas	Wood pellets	Wood logs	Wood chips
Fuel oil		Yes	No	No	No
Natural gas	Yes		No	No	No
Wood pellets	No	No		No	No
Wood logs	No	No	No		Yes
Wood chips	No	No	No	Yes	

Source: Johansen cointegration test results; Author's calculation

Case study: Wood fuel prices in Slovenia, Croatia and Romania

While the renewable energy sources already has a significant share in total energy consumption in countries like Sweden, Denmark, Germany and Austria, the share of RES in energy consumption is increasing all over the Europe in the last decade. This is also the case with countries in the region, like Romania, Slovenia and Croatia (Chart 4).

Chart 4. Renewable energy sources in total heating and cooling energy consumption (%)



Source: Eurostat

Table 7 presents the total energy consumption in heating and cooling, and the consumption of energy derived from RES, in Croatia, Slovenia and Romania. The share of RES in total heating and cooling energy consumption has increased in the period from 2004 to 2013 from 12% to 18% in Croatia, from 17% to 26% in Romania, and from 18% to 30% in Slovenia. In all these countries, the increasing shares of renewable in heating are mostly due to increased utilization of wood biomass in DHPs. The energy consumption from RES has increased for 75 ktoe in Croatia, 445 ktoe in Romania, and 145 ktoe in Slovenia during these ten years. Bearing at mind these figures, the Serbian national renewable energy plan's target of the increase of energy consumption from RES of 149 ktoe until 2020 could be evaluated as hardly achievable, at least without active governmental support.

Table 7. Renewable energy sources in heating and cooling energy consumption (in ktoe)

	Croatia			Romania			Slovenia		
	RES energy consumption	Total energy consumption	Share of RES in total	RES energy consumption	Total energy consumption	Share of RES in total	RES energy consumption	Total energy consumption	Share of RES in total
2004	377.9	3,239.0	12%	3,059.1	17,604.3	17%	430.0	2,391.2	18%
2005	351.8	3,265.1	11%	3,183.5	17,748.9	18%	439.6	2,369.9	19%
2006	364.0	3,200.5	11%	3,055.8	17,735.4	17%	420.4	2,314.4	18%
2007	324.5	3,076.6	11%	3,230.6	16,731.7	19%	407.2	2,044.4	20%
2008	326.5	3,146.5	10%	3,801.4	16,492.3	23%	401.0	2,149.0	19%
2009	342.5	2,946.8	12%	3,758.8	14,301.4	26%	503.2	2,088.4	24%
2010	387.2	2,989.7	13%	3,931.0	14,563.9	27%	538.1	2,182.7	25%
2011	448.1	2,876.3	16%	3,454.2	14,409.4	24%	554.5	2,039.8	27%
2012	479.2	2,652.5	18%	3,637.0	14,324.4	25%	552.9	1,926.4	29%
2013	453.0	2,548.3	18%	3,504.3	13,556.8	26%	575.1	1,905.0	30%

Source: Eurostat

Table 8 shows the prices of wood chips, firewood and heating oil (in EUR per MWh) in these three countries over the period from the second half of 2011 to the first half of 2014.

Several conclusions can be made from data in Table 8:

- 1. The prices of wood fuels in all three countries are on same or slightly lower level in 2014 relative to 2011;*
- 2. There were relatively high volatility in wood fuel prices over the period;*
- 3. There is no evident correlation between prices of wood chips and firewood over the period (except in Slovenia). Chart 5 provides the graphical representation of this.*

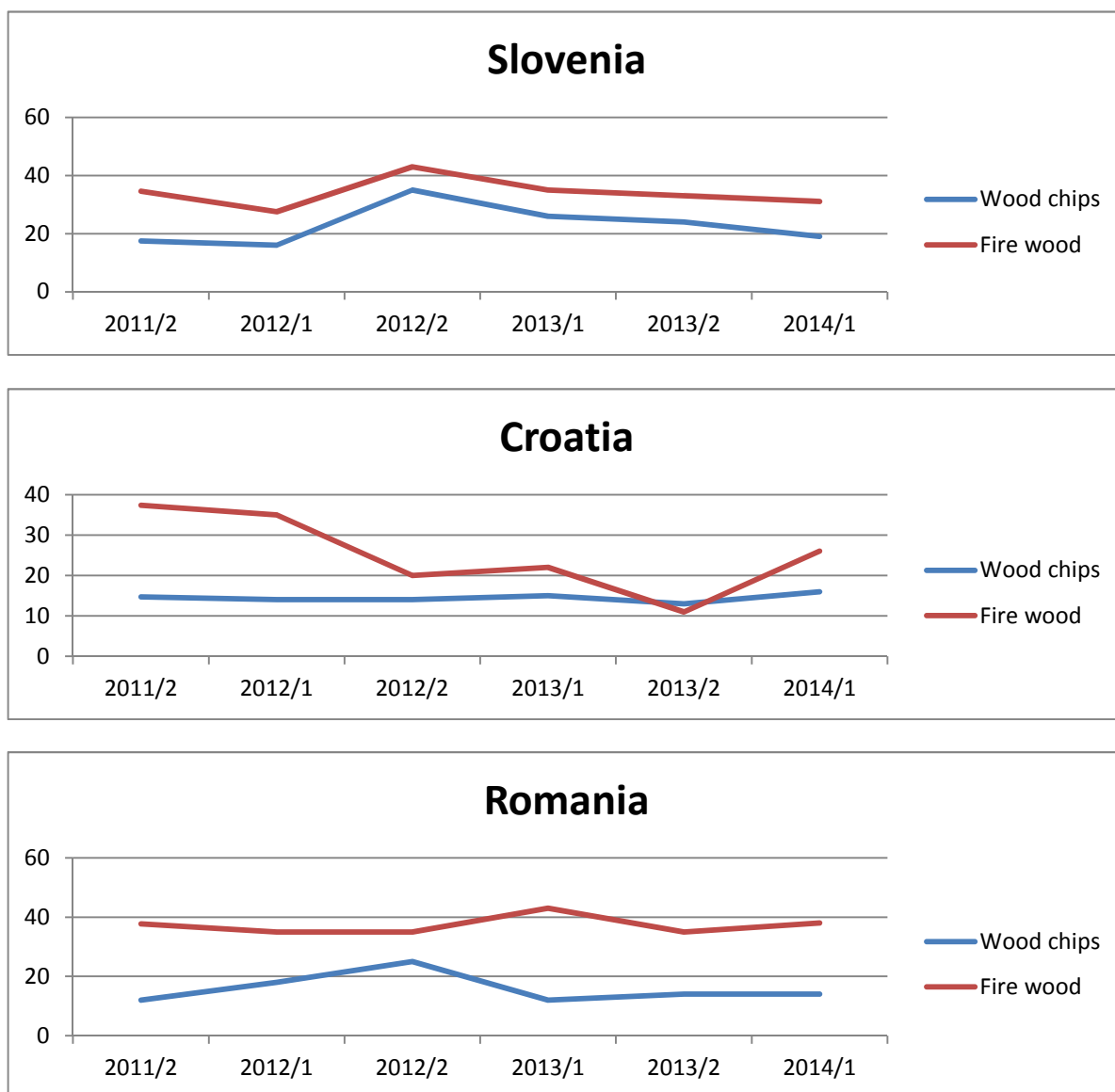
Table 8. Prices of different fuels in selected countries (in EUR/MWh)

		2011/2	2012/1	2012/2	2013/1	2013/2	2014/1
Slovenia	Wood chips	18	16	35	26	24	19
	Fire wood	35	28	43	35	33	31
	Heating oil	98	99	105	97	100	100
Croatia	Wood chips	15	14	14	15	13	16
	Fire wood	37	35	20	22	11	26
	Heating oil	97	84	95	95	86	87
Romania	Wood chips	12	18	25	12	14	14
	Fire wood	38	35	35	43	35	38
	Heating oil	116	115	122	131	119	121

Source: Biomass Trade Centre 2

While we found previously that the prices of different wood fuels are “moving together” over the long period, here we can conclude that there is no correlation between these prices over the short period. Explanation could be that in the long run wood fuels (all types) are competing with fossil fuels, but in the short run different wood fuels are not competing among themselves due to different feedstock for production. For instance, firewood is produced from round wood, while the wood chips could be produced from wood residuals in tree cuts.

Chart 5. Development of wood fuel prices in Slovenia, Croatia and Romania (EUR/MWh)



Source: based on Biomass Trade Centre 2 data

Case study: District heating plant Gradiska

District heating plant in Gradiska is the first DHP in the Republic of Srpska, Bosnia and Herzegovina that produce heat energy from wood biomass. Plant was put into operation at the beginning of 2014, by IEE company group. Old fuel oil boilers are replaced with two biomass furnaces with total capacity of 12MW. Annual production of heating energy is approximately 18,000 MWh. Plant supplies about 120,000 m² of residential and office space with heat in 24-hour mode.

Switch to biomass in DHP in Gradiska proved to have positive economic, social and environmental effects.

Before fuel switch DHP in Gradiska was near bankruptcy. Substantial financial losses had accumulated over the years. Municipal self-government of Gradiska had to spend approximately 1 million euros each year for co-financing the procurement of fuel oil, i.e. approximately 10% of its annual budget. After the fuel switch, DHP is operating without municipal government's financial support, meaning that 1 million euros are now disposable for other purposes in the municipal budget. Even more, municipal budget now generate revenues from renting or concession which IEE paid for use of the facilities of DHP and pipelines.

Beside positive budget effects, fuel switch in DHP has another, equally significant effect for the local community – job creation. All DHP workers have kept their jobs, while new jobs are generated throughout whole biomass supply chain.



From this study’s perspective, it was necessary to explore whether the fuel switch to biomass in DHP in Gradiska caused the increase of the wood price in the region, which would generate a significant negative effect of this project for local community, as majority of the local population use firewood as heating fuel.

DHP in Gradiska burn approximately 5,600 tons of wood biomass per heating season, which is equal to 8,520 solid m³. The plant is purchasing wood residuals and wood wastes from the region, and then produce wood chips at the plant site.

The operation of Gradiska DHP proved to have no effect on the firewood price in the region (Table 8). Explanation could be found in the fact that wood chips are produced from wood residuals and wood wastes, rather than from the round wood or logs. In that sense, wood chips and firewood could be observed as complementary, rather than competitive forestry products.

Table 9. Firewood prices (in EUR/loose m³)

	2014	2015	2016
Banja Luka	30-40	30-35	30-35
Gradiska	23-33	25-33	25-35

Source: based on official data

Conclusions

High dependency on energy imports and the effects of climate change are challenging modern economies and societies. Growing share of nationally available renewable energy sources in final energy consumption, as a solution for these issues, is in the focus of policy-makers. The major renewable energy source in many European countries, including Serbia, is wood biomass.

The Strategy of energetic development of the Republic of Serbia until 2025 set target of 27% of renewable energy sources (RES) in gross final energy consumption by 2020. In order to achieve this target, the share of RES in heating production in Serbia should be 30% in 2020. For realization of this plan, the share of RES in energy production of district heating systems in Serbia should be significantly increased. Current share is estimated at less than 1%.

Multiple macroeconomic benefits of biomass utilization in district heating systems are becoming more and more recognized from municipal authorities in Serbia. Even now, with low fossil fuels prices, wood is proven to be cheaper energy source than oil, oil derivatives or natural gas. With expected increase in fossil fuels prices, the demand for wood as an energy source will increase significantly, which will drive the competition for this desirable raw material.

The increased competition for the wood, between different forms of its usage (as energy source and as a material), as well as the increasing competition for energy wood among different consumers (households, industry, energy sector) is rising the question of its further price development. Substantial increase in wood price would significantly undermine economical basis of its usage as an energy source. Also, increased price of wood could have significant social impact in developing countries (as in Serbia), as the firewood is the major heating fuel among the economically vulnerable groups.

The use of firewood in Serbia has a highly expressed social component because it is the only available energy-generating product for a large part of the population. Redirection of firewood market from present consumers to another consumption type (district heating systems, pellets, wood panels, etc.) could lead either to social problems (because of the reduction of firewood supply for population) or to increased scope of forest use (over the allowed limits), namely social and economic component of forest management would be significantly jeopardized (Vasiljevic, A., 2015).

The objective of this study was to estimate the potential impact of the rising usage of wood as a fuel in district heating and CHP plants in Serbia on firewood price.

To achieve national renewable energy targets in the sector of heating and cooling until 2020, the Republic of Serbia should use far more biomass than now. This study estimated that additional 37.5 ktoe should be produced from wood biomass in DHPs and CHPs in 2020, compared to 2015. It is equal to 7% of total energy output of all DHPs in Serbia in 2015. To achieve this goal, additional 123,251 tons of wood biomass would be needed, which is equivalent to 200,642 solid m³ of wood, i.e. 501,606 loose m³ of wood chips.

As current wood chips production in Serbia is estimated at 300,000 loose m³, with additional 501,606 loose m³ of wood chips, the total wood chips production in Serbia in 2020 would be approximately 801,606 loose m³. This huge growth could be achieved until 2020 only with 27% of annual increase in production of wood chips, which presents the huge growth potential for wood processing industry in Serbia. On the other hand, as total wood fuel production in Serbia in 2015 is estimated at 3,670,831 tons, additional 123,251 tons of wood biomass represents the increase in production of only 3.3%.

The growing demand for wood fuels in Serbia is not going to be the result of fuel switch to biomass in DHPs and CHPs only. National RES energy action plan assume that the set targets will be met only if additional 50 ktoe of heating energy would be produced from biomass in individual households. It is estimated that additional 47.5 ktoe of heating energy annually should be produced from firewood in 2020. Additional 217,000 tons of firewood would be needed annually to achieve this. This represents the 6% increase in wood fuels production (and firewood production) compared to 2015.

If all aspects of increased wood fuels utilization according to the national RES energy action plan are considered (increased heat production in DHPs, increased heat production in individual households, and increased heat production in CHPs) the wood fuels demand would increase for additional 340,251 tons of wood in 2020 compared to 2015, which is an increase in wood fuels production of 9.3% in next 4 years.

The econometric analysis conducted in the study on the sample of Austria, Slovenia, Croatia and Romania, showed that there is no long run co-movement between wood fuel price and consumption. This suggests that growing demand of wood fuels due to the increase in biomass-based production of heat and electricity was followed by the increasing supply. This result is in line with results of some earlier studies: for example, the same was observed in Sweden during the 1990's, when in spite of increasing demand for wood fuels, the price of the wood fuels stayed relatively constant due to a stable supply of residues from the forestry sector (Hillring, 1999). However, the role of the government can be crucial here. If the increase in the demand is rapid, financial and fiscal stimulus should be provided in order to support the increase in wood fuels supply at the same pace.

Econometric model has also shown that there is long run co-movement in prices of different fuels of the same type of the same type (fossil or wood). On the other hand, there is no co-movement in the prices of fossil and wood fuels, even though these two types of fuels could

be observed as substitutes. The explanation could be the relatively short period of observation (9 years), as once installed capacities in DHPs and CHPs could not be changed in short run.

Experience in development of RES market from countries from the region could be valuable for Serbia. The share of RES in total heating and cooling energy consumption has increased in the period from 2004 to 2013 from 12% to 18% in Croatia, from 17% to 26% in Romania, and from 18% to 30% in Slovenia. In all these countries, the increasing shares of renewable in heating are mostly due to increased utilization of wood biomass in DHPs. The energy consumption from RES has increased for 75 ktoe in Croatia, 445 ktoe in Romania, and 145 ktoe in Slovenia during these ten years. Bearing at mind these figures, the Serbian national renewable energy plan's target of the increase of energy consumption from RES of 149 ktoe until 2020 could be evaluated as hardly achievable, at least without active governmental support.

When speaking about the impact of rising wood biomass demand on firewood price in these countries, the study has shown that, despite significant growth in the wood biomass market, the price of firewood was not affected.

When thinking about the relation between prices of wood chips and firewood it is crucial to bear in mind that these two wood fuels are supposed to be produced from different feedstock. While firewood is produced from round wood and logs, the wood chips are mainly produced from wood residuals in tree cuts and wood wastes in wood processing industry. This view is also confirmed from the experience of Gradiska DHP in Republic of Srpska. DHP in Gradiska burn approximately 5,500 tons of wood biomass per heating season, which is equal to 8,520 solid m³. As this case study has shown, this amount proved to have no effect on the firewood price in the region.

Based on all study results, the general conclusion would be that growing wood biomass market in Serbia should not have significant impact on firewood price. This conclusion stands even for the scenario where the national strategy targets for the share of RES in gross final energy consumption are achieved until 2020. The key fact here is the fact that fuel switch in DHPs in Serbia from fossil to wood fuels would give a momentum to wood chips production, which is complementary, rather than competitive forestry product compared to firewood.

On the other hand, some arguments, basically from the experience from countries from region, put some doubts that strategy targets for the share of RES in energy consumption are achievable in such a short run, until 2020.

At the end, when speaking about firewood price development in Serbia, it is reasonable to conclude that the major threat is not the growing wood biomass market, but loose control over the cuts in private forests and irresponsible forests management. With this issue solved (as planned) and with active support and strategic orientation of government, the wood biomass market could be developed without threatening the social and economically

vulnerable groups. As a matter of fact, wood biomass market development could be beneficial for economy and local society, among other things, by creating new jobs and by increasing income of rural population.

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