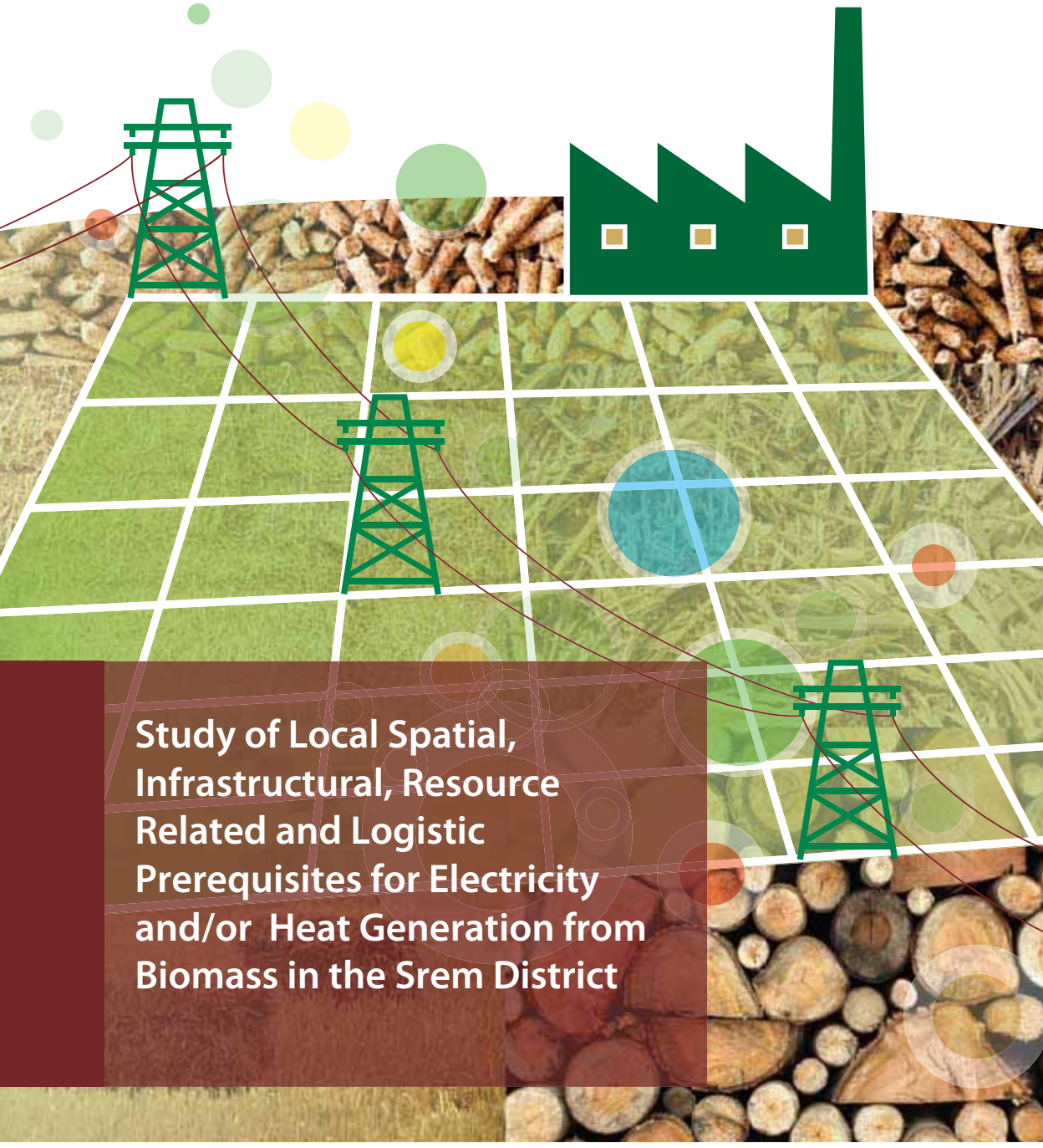
Mapping of the Municipal Spatial, Infrastructural, Resource Related and Logistic Prerequisites for Electricity and/or Heat Generation from Biomass in the Srem District

Standing Conference of Towns and Municipalities

National Association of Local Authorities in Serbia



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Belgrade, 2015

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Foreword

It is a well known fact that biomass is individually the most significant renewable resource potential in Serbia, but it is also a fact that this energy source is still far from being sufficiently or adequately utilized. In terms of energy, biomass is both a great opportunity and responsibility for local government units. That means that switching from conventional and, as a rule imported, energy sources to renewable sources, i.e. biomass, in district heating systems, cities and municipalities could achieve multiple benefits for themselves and their citizens in terms of security of supply, service quality, activating local capabilities, boosting local economy and, finally, alleviating the burden on local finance. For the above reasons, local self-government units also have the responsibility to initiate the process and create institutional, regulatory and infrastructural prerequisites for a more widespread use of biomass on their territories for local needs.

For the reasons above, this Study should serve the Srem District municipalities to review biomass potentials on their territories, as well as currently available and future required infrastructural prerequisites for its more intensive use. In this way, local self-government units, equipped with arguments, will be an equal party to any future negotiations that may be held with potential investors in this area.

The Study is a result of the project "Mapping of the Municipal Spatial, Infrastructural, Resource Related and Logistic Prerequisites for Electricity and/or Heat Generation from Biomass in the Srem District", implemented, between December 2013 and April 2015, by the Standing Conference of Towns and Municipalities of Serbia in cooperation with the Regional Development Agency of Srem and financially supported by the Embassy of Finland in Serbia.

The aim of the Project is to contribute, through the development of a methodology for mapping of the municipal spatial, infrastructural, resource related and logistic prerequisites for electricity and/or heat generation from biomass and the Study, to the intensification of investment activities relating to the use of biomass for energy generation at the local level as well as for the raising of general awareness at the local level on the importance and potential of biomass as a renewable energy source.

The pilot region selected was the Srem District as it stretches between the Sava and Fruska Gora, which is an area with varied biomass potential, comprising seven municipalities of different size, type and number of inhabitants. Moreover, the Srem District is well known for strong local actors who were ready to support the implementation of project activities.

Last but not the least, the Study also covers the gender aspect of using biomass at the local level, to contribute to better understanding of the gender perspective and create affirmative actions to empower women in this field.

The authors would hereby like to thank all their colleagues for the support for and assistance in the development of the Study.

Project Team:
"Mapping of the Municipal Spatial, Infrastructural, Resource Related and Logistic Prerequisites for Electricity and/or Heat Generation from Biomass in the Srem District"

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List of Acronyms

AE	Absolute elevation
APV	Autonomous Province of Vojvodina
EEAP	Energy Efficiency Action Plan
GNP	Gross national product
GFEC	Gross final energy consumption
GHG	Greenhouse gases
FMU	Forest management unit
MMRS	Main measurement and regulation station
MJP	Main junction point
EE	Energy efficiency
EEC	European Economic Community
EnC	Energy Community
EC	European Community
EU	European Union
EC	European Commission
CAP	Common Agricultural Policy
PWC	Public water-management company
PUC	Public utility company
PE	Public enterprise
NREAP	National Renewable Energy Action Plan
UUA	Utilized agricultural area
Ktoe	Kiloton of oil equivalent
Mtoe	Million tons of oil equivalent
MGP	Main gas pipeline
MRS	Measurement and regulation station
RES	Renewable energy sources
AH	Agricultural holding
FAH	Family agricultural holding
DGP	Distribution gas pipeline
SORS	Statistics Office of the Republic of Serbia
RS	Republic of Serbia
DHS	District heating system
SCTM	Standing Conference of Towns and Municipalities

TEM	Trans European Motorways
[toe]	Ton of oil equivalent, natural energy unit, 1 = 42 GJ
LU	Livestock unit
TeEC	Treaty Establishing the Energy Community
CC	Constitutional Court
FH	Forest holding

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1. Project Background

The Republic of Serbia is very much dependent on fossil fuel imports, where a large part thereof is used to generate energy for heating. The application of biomass in technical systems for electricity and/or heat generation does not have an adverse environmental impact, can generally be locally available and, as such, is a cost-effective solution. Biomass cannot completely replace other energy sources, but can significantly contribute to the reduction of energy needs both at the local and the global level with reduction of green house gas emissions.

Be it construction of new electricity and/or heat generation plants or reconstruction of the existing systems, the above activity is undertaken to ensure efficient operation of such systems over a longer period of time, particularly bearing in mind the age of the existing district heating systems, and the age of local individual heating systems in the Republic of Serbia. Therefore, it is very important to assess all the possibilities before embarking on construction/reconstruction, including the possibility to use biomass.

The energy potential of biomass generally depends on a large number of factors. The most important are: availability of biomass, cost-effectiveness, level of biomass market development, economic incentives, possibility to apply some other traditional or renewable sources of energy, as well as other resource capacities in a given area. Designed energy potential of biomass in this respect greatly depends on the assumptions and applied availability and usability models.

The Activity Plan for the Project for "Mapping of the Municipal Spatial, Infrastructural, Resource Related and Logistic Prerequisites for Electricity and/or Heat Generation from Biomass in the Srem District" provided for the development of the Study of Spatial, Infrastructural, Resource Related and Logistic Prerequisites for Electricity and/or Heat Generation from Biomass in the Srem District to properly analyze any opportunities to apply biomass in the above area.

The importance of this Study is in its analysis of potential spatial, infrastructural, resource related and logistic prerequisites for electricity and/or heat generation from biomass. Since the real opportunity for utilizing biomass for electricity and/or heat generation on the territory of the Srem District municipalities does not only depend on the availability of different types of biomass, but also on energy needs, or energy consumption in the territory of each Srem District municipality, special attention is devoted to this very fact. In addition, special attention in the Study is devoted to infrastructural capacity of each municipality. The mapping methodology was developed along those lines.

The relevant data required for the development of this Study were collected from reference documents and from direct contact with municipality representatives (questionnaires and workshops). Official national and local statistics were used as the main basis for the development of the Study.

2. Situation in the EU

According to EUROSTAT data for 2011, total energy dependency of the EU was 53.8%, and the value of annual fossil fuel imports amounted to:

- crude oil: 511 Mt
- natural gas: 13522 PJ
- coal: 202 Mt

The import of crude oil into EU member states witnessed a 5% decline in the period 2001-2011. The largest crude oil supplier in 2011 was the Russian Federation with a share of 35% of total imports. The import of natural gas in the EU grew by 46% in the period 2001-2011. Russia was also the largest natural gas supplier in 2011 with a share of 30% of total imports. The import of coal in the EU also grew by 11% in the period 2001-2011. Compared with the reference year of 2001, the imports of coal from Russia, USA and Columbia doubled in 2011. The largest suppliers of coal to the EU were Russia with 26% share and Columbia with 24% share of total imports of coal. On the other hand, by 2011, EU member states reduced the total consumption of energy and energy sources by 5.7% compared to the reference year of 2008.

The EU energy dependency is reflected in a large outflow of EU gross domestic product (GDP), exhibiting a rising annual trend. In 2011, the EU spent EUR 406 billion for the import of fossil fuels, while the amount in 2012 was EUR 545 billion, or 4.2% of the EU GD. The EU is very dependent on the import of various energy sources from abroad, and actually it spends more than a billion euro daily for the import of 53% of all the above energy sources. These include:

- 88% of its total crude oil needs,
- 66% of its total natural gas needs,
- 42% of its total solid fuels (e.g.: coal) needs,
- 95% of its total uranium needs.

The above figures indicate exceptional EU dependency with regard to energy supply, as well as its vulnerability to potential energy supply crises. Many member states rely heavily on only one supplier of a particular energy source, including the six member states that are completely dependent on Russia for the import of natural gas. Three member states - Estonia, Latvia, and Lithuania – also rely on only one external operator for the operation and load balancing of their electricity distribution network, and a large share of import of needed quantities of electricity comes from only one supplier.

The true nature of such dependency became obvious during the shortage of natural gas in the winter of 2006 and 2009, due to the crisis of natural gas supply, that is, transport of natural gas through Ukraine. Responding to the events in Ukraine, in March 2014, the European Council called on the Commission to develop a detailed study on the European energy security and to present a comprehensive plan for reducing the EU energy dependency.

During previous years, the lack of awareness and full political support for the implementation of projects in the field of renewable energy sources for electrical power generation and in the heating and cooling systems resulted in modest development of this market and significantly weaker results than the set targets.

On the other hand, all performed analyses [1] indicate that biomass will become the most important renewable resource potentially if all complementary technologies within available renewable energy sources in 26 states, whose overall energy consumption amounts to 75% of total global needs, are implemented in practice by 2030. In that case, biomass would have a 60% share of global available renewable energy and thus its use would be dominant in all sectors of final energy consumption. In this way, biomass would then have a 20% share of primary energy use at the global level, and double the share of 10% from 2010.

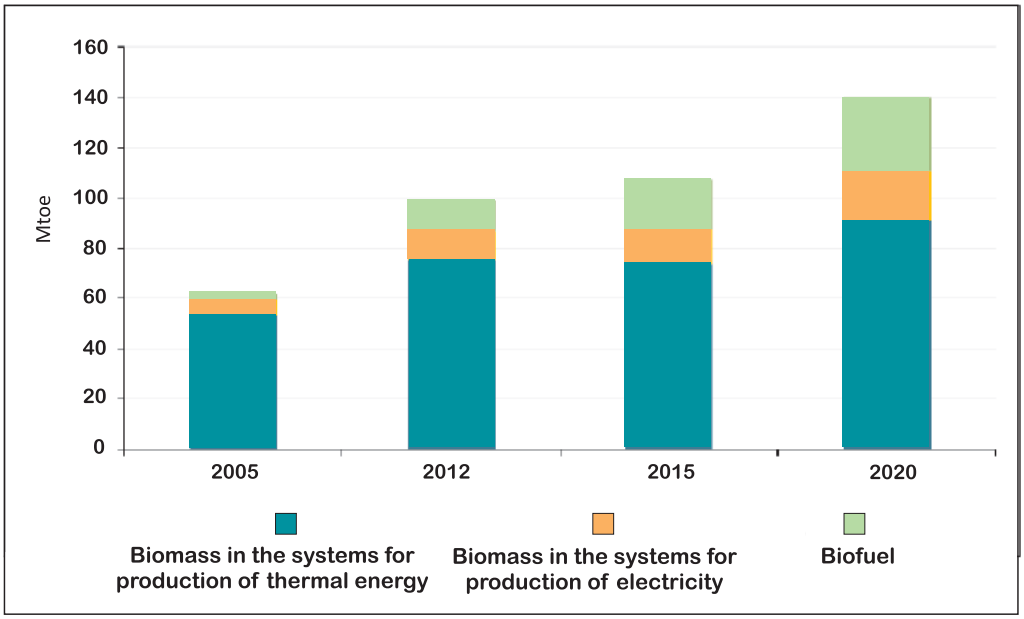


Figure 1 – Consumption of biomass in the systems for the production of electricity, heat, and biofuel on EU territory

Solid biomass and biogas are used for the generation of electricity, heating and cooling and have the largest share in the generation of energy from renewable sources in the

EU. In addition, further forecasts and expectations go in the direction of solid biomass and biogas having a major contribution in achieving the goal of increasing the share of energy generation from renewable sources to 20% by 2020. The use of sustainable sources of biomass may play an important role in overcoming the problems arising from climate change and energy supply safety, at the same time contributing to economic development and employment, particularly in rural areas.

Figure 1 shows the consumption of biomass in the heating and electricity generation systems in the EU. A significant increase in the consumption of biomass can be observed in the above systems comparing the consumption in 2005 and 2012. According to estimates contained in the member states' national renewable energy action plans, the projections of biomass consumption move from 86.5 Mtoe (million tons of oil equivalent) in 2012 to 110.5 Mtoe in 2020, although the forecasts are that its share in the total final consumption of renewable energy will be reduced from 54% to 45%, due to faster development of other types and technologies of renewable sources. By the end of the decade, on the basis of the current trend, the expected use of biomass in electricity and/or heat generating systems is as follows: up to 90.4 Mtoe in heat generation systems (heating systems), while in electricity generation systems the increased consumption should reach 20 Mtoe.

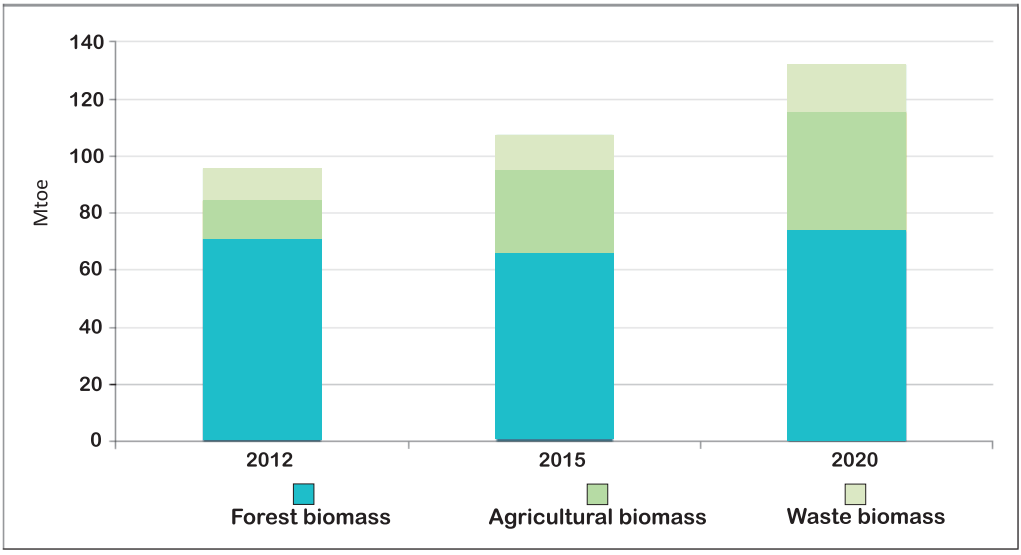


Figure 2 – Estimates of supply and share of biomass sources in the systems for the production of electricity, heat, and biofuel in the EU for the period 2012-2020

During 2012, the consumption of biomass in EU27 electricity generating systems and heat generating systems (heating and cooling systems) amounted to 103.3 Mtoe, mostly domestically produced (95.7 Mtoe). According to collected and analyzed data from national renewable energy action plans of member states and assessments, the

estimated increase in the use of biomass in future reaches almost 37%, or 132 Mtoe by 2020 – Figure 2. Similar plans for a somewhat smaller increase of consumption were also made for forest biomass, from 71 Mtoe in 2012 to 73.6 Mtoe in 2020, although, on the other hand, the projections indicate a drop in relative share of total available supply of biomass from 74.4% to 55.7%.

2.1. Legal Framework

The Renewable Energy Directive was published in the Official Journal of the European Union at the beginning of June 2009, and came into force on 25 June of the same year. Member states were obligated to transpose the Directive into their national legislations by December 2010. This Directive was published as part of the climate and energy legislative package adopted by the Council in April 2009. The climate and energy package includes the following pieces of legislation:

- Regulation (EC) No 443/2009 - on the reduction of CO2 emissions from light-duty vehicles, [2]
- Directive 2009/28/EC – on the use of renewable sources (RED), [3]
- Directive 2009/29/EC– ETS Directive – on the EU system of emission trading scheme, [4]
- Directive 2009/30/EC – Fuel Quality Directive (FQD), [5]
- Directive 2009/31/EC – on the geological storage of carbon dioxide, [6]
- Decision No 406/2009/EC – on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020, [7]

In addition, the European Parliament legislative resolution of 17 December 2008 specifically sets the 20/20/20 target (increasing the share of overall energy consumption produced from renewable resources to 20%, a 20% reduction in greenhouse gas emissions, and a 20% reduction of energy consumption by 2020).

The Common Agricultural Policy of the European Community (CAP) treats renewable energy in its second pillar: the rural development framework. The CAP provides for a possibility of supporting investments and infrastructure relating to establishing energy plantations and sowing various crops such as energy crops (short rotation coppice), or other species (grasses) for energy purposes (Miskanthus, perennial grasses (Panicum virgatum commonly known as switchgrass), reed canary grass (Phalaris arundinacea), etc. The CAP post-2013 also requires farmers to maintain an ecological focus area of at least 5% of eligible hectares (above 15 hectares of arable land) in the form of fallow land, terraces, landscape features, buffer strips, and afforested area. There are indications that the percentage of such mandatory ecological focus areas of

land could increase to 7% after the Commission Report in 2017. Member states have a possibility to grow perennial energy crops in these ecological focus areas, provided that no pesticides or fertilizers are used in growing them. At the time this Study was being prepared, various modalities and manners of CAP implementation were still being considered, [8].

In February 2010, the European Commission published a report on sustainability requirements for the use of solid biomass and biogas (obtained by gasification of biomass) in electricity, heating and cooling [9]. This Report provides recommendations for the Member States that have already defined or are planning to introduce sustainability criteria in their national legislation. Moreover, the subject matter of this Report is the obligation of the Commission to make an assessment of the need to harmonize national schemes at the EU level. Towards the end of July 2014, the European Commission published its new report on the sustainability of use of solid biomass and biogases (obtained by the gasification of biomass) and their application in the generation of electricity, heating and cooling systems. The report comprises three documents:

- State of play on the sustainability of solid and gaseous biomass used for electricity, heating and cooling in the EU, SWD(2014)259, [10].
- Solid and gaseous bioenergy pathways: input values and GHG emissions – Report EUR 26696 EN, [11]
- Review of literature on biogenic carbon and life cycle assessment of forest bioenergy.

On the basis of prepared documents and performed analyses, the Commission concluded that a vast majority of measures for the use of solid and gaseous biomass to achieve the EU target of increasing the share of overall energy consumption produced from renewable resources to 20% was associated with significant reduction in greenhouse gas emissions. The Commission therefore decided to maintain the opinion of the first assessment report (COM/2010/11) from 2010 [9], and will not propose the introduction of binding sustainability requirements on the EC level for solid and gaseous biomass.

In January 2014, the European Commission launched an initiative to set a target of 40% GHG reduction compared to 1990, by 2030. It was also agreed that present policies and measures implemented or planned by member states with regard to their current GHG reduction obligations would also be calculated past 2020. In the meeting held on 23 October, the European Council finally adopted the agreement on the framework for climate and energy policies for the period 2020-2030. Heads of 28 EU member states decided that by 2030, the EU must reduce the greenhouse gases (GHG) by 40% compared to baseline 1990. More precisely, the industrial sectors included in the European Emissions Trading System (liable entities – power plants, foundries, paper mills , etc), must reduce their emissions by 43%, while non-ETS sectors (buildings, transport, small enterprises, etc.) must globally reduce their greenhouse gas emissions by 30%. The remaining three targets are part of the climate and energy agreement reached in Brussels.

The first refers to renewable energy that should have a share of at least **27% of the European gross final energy consumption**. However, this mandatory target must be

achieved at the European level, and does not involve any specific and additional enforcement obligations for individual EU member states.

The second target is only indicative and refers to energy efficiency: by 2030, the EU must reduce its overall energy consumption by at least 27% compared to the calculated level of consumption for 2007 (baseline consumption).

In addition, the agreement also obligates all EU member states to be well connected with energy grids of their neighbors by 2030. More precisely, each member will have to establish interconnections with electrical grids of neighboring states, at least equivalent to 15% of their installed production capacity.

Standardization – a large number of EN standards cover terminology, definitions and characteristics of solid biofuels. These standards were developed by the European Committee for Standardization (CEN), which is a platform for the development of European standards and other technical specifications intended to remove trade barriers for European industries and consumers.

3. Use of Biomass in the Republic of Serbia

3.1. Land

The Republic of Serbia has 5.06 million hectares of agricultural land, of which 71% of area is used intensively (in the form of arable land, orchards and vineyards), while 29% of agricultural area comprises natural grassland (meadows and pastures) - Figure 3. A predominant part of agricultural area, 3.3 million hectares or 65%, is utilized as arable land, of which annually 7% is utilized (remains fallow). In addition to areas that lie fallow, a significant part of the area under meadows and pastures is unutilized due to inaccessibility, weediness, or cost-ineffectiveness. It is estimated that each year between 200 and 350 thousand hectares of arable land and meadows remain uncultivated, while the surface area of unused agricultural land with pastures is much larger - Table 1, [12].

Table 1 – Volume and structure of agricultural areas of the Republic of Serbia

	2011	2012	2013
Agricultural land, total	5056000	5,053000	5,069000
arable land	3294000	3282000	3298000
fallow land	224000	219000	242000
Permanent plantations	296000	293000	289000
fruit plantations	240000	239000	238000
vineyards	56000	54000	51000
Permanent grassland	1466000	1478000	1482000
meadows	621000	641000	653000
pastures	845000	837000	829000

In terms of volume and structure of available agricultural area, the Republic of Serbia is one of the European countries with favorable land resources, considering it has 0.7 ha of agricultural or 0.46 ha of arable land per capita. At the same time, the ratio of surface area of arable land and permanent crops to the surface area of meadows and pastures is among the more favorable ones among European countries (71:29%). There is great variety of soils in the Republic of Serbia, resulting from great heterogeneity of geological structure, climate, vegetation and microfauna. Two thirds of agricultural land is located in the areas where, owing to favorable precipitation patterns, growing crops is possible for over 200 days a year. About 45% of agricultural land is suitable for

cultivation with no significant limitations, while the rest is agricultural land generally not suitable for cultivation or can be cultivated with significant limitations, [12].

According to the Census of Agriculture 2012 [13], 631522 agricultural holdings using 3.437 million hectares were enumerated in the Republic of Serbia.

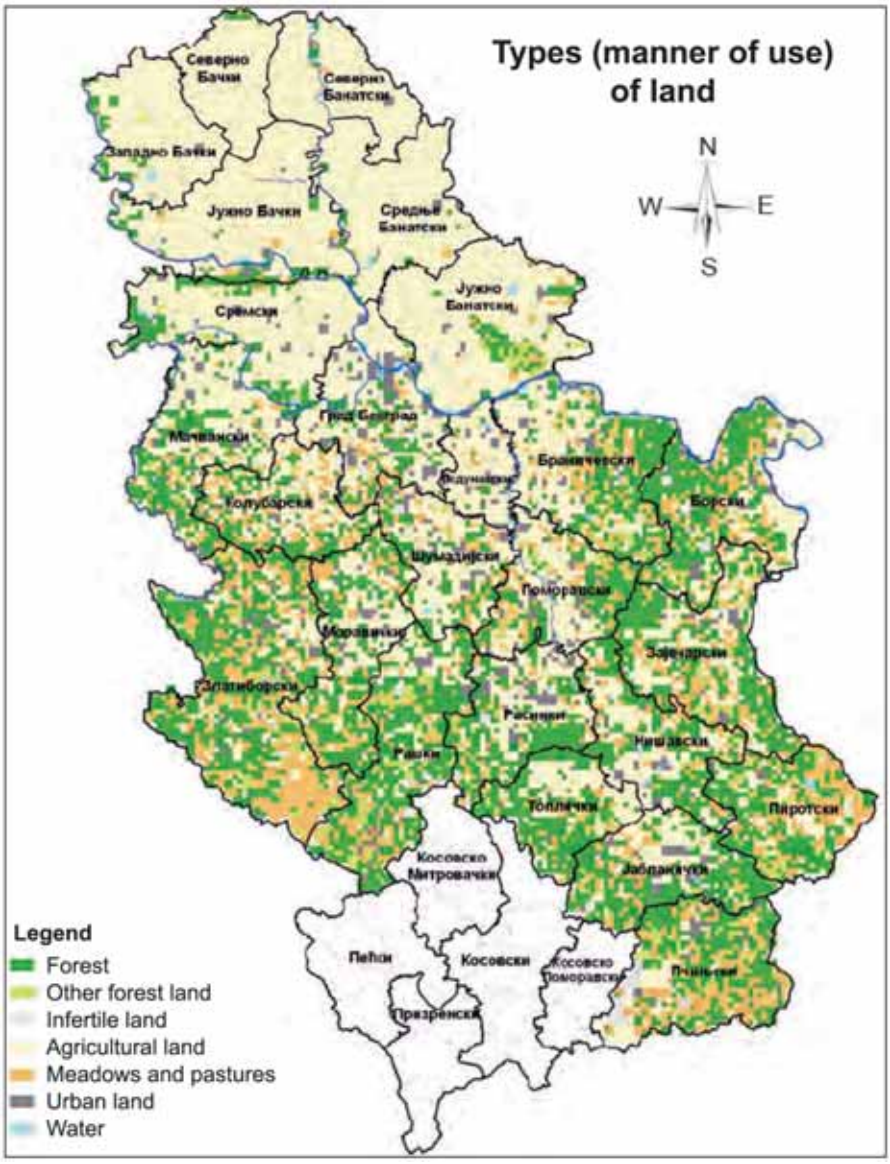


Figure 3 – Type and manner of land use [Source: The National Strategy for the inclusion of the Republic of Serbia in the Clean Development Mechanism of the Kyoto Protocol to the sectors of waste management, agriculture and forestry ("Off. Gazette of RS", no. 8/2010)]

The average utilized agricultural area per holding is 5.4 ha. Among the enumerated agricultural holdings, 99.6% are holdings of natural persons, using 82% of area. The average size of the family holdings is 4.5 ha, and varies significantly by region - from 2.1 ha (Jablanica area), to over 10.0 ha (Srednji Banat area). The remaining 0.4% of agricultural holdings is owned by legal entities, utilizing 16% of area and having an average size of 210 ha per agricultural holding.

A general conclusion is that there is a visible process of concentration and centralization of agricultural holdings by size, which is more prominent in AP Vojvodina than the rest of the country. Of the total number of enumerated agricultural holdings, 3.1% are over 20 ha, and they use 44% of utilized agricultural area (hereinafter: UAA). On the other hand, agricultural holdings utilizing up to 5 ha make up 77.7% of the total number of holdings enumerated, and they use 25.2% of UAA. Such holding structure (with a large number of small size holdings) is typical for the agricultural model in the countries of South Europe. Nevertheless, there are some deviations in the Republic of Serbia compared to neighboring countries in terms of a larger share of agricultural holdings with 2-10 ha in the total number of holdings (43%) and utilized areas (35.3%).

3.2. Forests

The Republic of Serbia is considered a medium-forested country. Forest cover is, when compared on a global scale, similar to world forest cover, which is 30%, but it is considerably lower than the European 46% (2000). The increase in forest cover compared to the reference year of 1979 is 5.2%, which undoubtedly had a positive impact on the state and quality of the environment as a whole. The Applicable Law on Forests [14], define forest as an area of land over 5 ares covered with forest trees. Forest also includes forest nurseries in forest complexes and seed plantations as well as shelterbelts of the area greater than 5 ares. Forests do not include separate groups of trees on the surface area of less than 5 ares, parks in populated settlements, nor trees placed under power transmission lines, and in the transmission line buffer corridor, regardless of the surface area.

According to the Statistical Office of the Republic of Serbia, the total forested land in the Republic of Serbia is 1962335 ha. Of those, 927773 ha, or about 47% of the total forested land is state owned, while the remaining 53% of forested land is privately owned – Table 2. In addition, according to the National Forest Inventory the above values are estimated at a slightly higher level, which can be ascribed to the methodological approach.

The timber cut in forests in 2013 is greater than in 2012 and amounts to 2656 thousand m^3. The timber cut in the state-owned sector is 2166 thousand m^3, much more than in the private sector, which makes up approximately 82% of the total timber cut. The timber cut in pure stand forests amounts to 1877 thousand m^3, and in mixed stand forests to 779 thousand m^3. With regard to pure coniferous and broad-leaved stands, 1731 thousand m^3 of pure broad-leaved stands and 146 thousand m^3 of pure coniferous stands were cut.

Re/afforestation in 2013 exceeded that of 2012 by 59 ha, which is an increase of about 3% over the previous year. The total re/afforested area in 2013 amounts to 2194 ha. The area re/afforested with coniferous species is 735 ha, or about 33% of the total area re/afforested in 2013. The area of 1808 ha in the state sector, and 386 ha in the private sector was re/afforested. Fire damage in 2013 was recorded on 561 ha, with 7343 m3 of damaged timber [15]. Tables 2 and 3 show the data from the National Forest Inventory [16].

Table 2 – Basic data on Serbian forests

2008	Unit	Data Source:	
		Statistical Office of RS	National Forest Inventory
Forested land – total	[ha]	1971489	2252400
Central Serbia	[ha]	1863222	
Vojvodina	[ha]	108267	
Share of forested land – total	[%]	25	29.1
Central Serbia	[%]	33	37.6
Vojvodina	[%]	5	7.1

Under the current Law on Forests, forest title holder means a natural or legal person (company, cooperative, church and religious community, association) who has title over the forest.

Table 3 – Forest land in the Republic of Serbia by ownership type

2008	Data source:			
	Statistical Office of RS		National Forest Inventory	
Unit	**[ha]**	**[%]**	**[ha]**	**[%]**
State-owned forests	942877	47.8	896400	39.8
Central Serbia	839454	45		
Vojvodina	103423	96		
Privately owned forests	1028612	52.2	1175200	52.2
Central Serbia	1023768	55		
Vojvodina	4844	4		
Other owners			180800	8.0

The title holder or user is obligated to undertake forest protection measures, protect forests and wooded land from degradation and erosion, implement forest management plans. The Republic of Serbia manages forests through the Ministry, through competent authority of the autonomous province, and through state-owned legal forest management entities, and forest management legal entities of title holders.

State-owned forests included in a forest area or national park area are managed by a public enterprise or company founded by the Republic of Serbia or autonomous province which meets the requirements stipulated in this law and special regulations. State-owned forests not included in a forest area or national park area may be managed by a public enterprise or company founded by the Republic of Serbia or autonomous province which meets the requirements stipulated in this law and special regulations.

JP Srbijašume manages over 77 % of state forests, *JP Vojvodinašume* about 11%,, while the national park public enterprises manage 8 % of state forest area. Other users have less than 1 % share. Private forests are managed by the owners themselves. However, under the current Law on Forests, public enterprises for forest management or companies managing state forests in forest areas and public enterprises in national parks on whose territory privately owned estates are located are entrusted with professional and technical tasks (tasks in the forests for which a program is developed) in private forests.

Table 4 – Timber cut

2009	Total		Technical wood	
	Hardwood	Softwood	Hardwood	Softwood
	[m³]			
Timber cut – total				
Republic of Serbia	2347094	256369	730975	204215
Central Serbia	1728861	245664	382524	197543
Vojvodina	618233	10705	348451	6672
Timber cut in state-owned forests				
Republic of Serbia	1763282	215463	660351	169313
Central Serbia	1150436	204758	312808	162641
Vojvodina	612846	10705	347543	6672
Timber cut in privately owned forests				
Republic of Serbia	583812	40906	70624	34902
Central Serbia	578425	40906	69716	34902
Vojvodina	5387	0	908	0

3.3. Volume and Structure of Agricultural Production

Agricultural production in the Republic of Serbia is mostly extensive, and as such exposed to a strong impact of weather, particularly drought. The low level or lack of agro-technical measures in plant production, small percentage of irrigated areas, insufficient genetic potential and unbalanced animal feed have major consequences in terms of oscillations in plant and livestock production.

3.3.1. Plant Production

Within plant production, crop farming and vegetable growing, which, in the Republic of Serbia, take place on 3.3 million hectares, occupy a prominent place in terms of share of total value.

Trends in international markets for agricultural products had an impact on the sowing structure in the Republic of Serbia, which has significantly changed in the past several years. The area under cereals has remained relatively constant (1.9 million hectares), but this group has seen redistribution towards an increased share of maize at the expense of wheat, whose share in the overall sown areas has dropped. The wheat price rise made producers redirect their efforts towards the production of maize, whose sown areas have in the past few years increased by about 10%, while around the middle of the last decade, the area under wheat dropped for the first time to below 500 thousand hectares – Table 5.

Table 5 – Provisional crop balance

	Unit	**2010/11 X-IX**	**2011/12 X-IX**	**2012/13 X-IX**	**2013/14 Estimate X-IX**	**2014/15 Forecast X-IX**
Maize production						
Sown/Harvested area	[ha]	1230000	1258000	1 268000	1186000	1085000
Yield	[t/ha]	5.8	5.1	2.8	4.9	6.7
	Unit	**2010/11 VII-VI**	**2011/12 VII-VI**	**2012/13 VII-VI**	**2013/14 Estimate VII-VI**	**2014/15 Forecast VII-VI**
Wheat production						
Harvested area	[ha]	489000	493000	481000	563000	610000
Yield	[t/ha]	3.3	4.2	4.0	4.8	3.8
	Unit	**2010/11 X-IX**	**2011/12 X-IX**	**2012/13 X-IX**	**2013/14 Estimate X-IX**	**2014/15 Forecast X-IX**
Soy production						
Sown/Harvested area	[ha]	170000	165000	164000	161000	
Production	[t]	541000	441000	292000	392000	
Yield	[t/ha]	3.18	2.67	1.78	2.43	

Source: [17]

Maize is the single most important Serbian agricultural product, with average production of about 5.6 million tons in the past decade and sown areas of about 1.2 million hectares. The production of wheat is about 2 million tons, and sown areas amount to about 500 thousand hectares – Table 5. A large share of wheat in the sowing structure, as well as lower yields compared to developed countries are a reflection of extensive production on a large number of small agricultural holdings, which insufficiently comply with the crop rotation and crop sequence requirements, and agro-technical measures.

Industrial crops are grown on 400-440 thousand hectares, but the areas with any crops from this group vary widely in size. Industrial crop production makes up about 8% of the total value of the Republic of Serbia agricultural production. Generally, in the above period, the areas under oilseed crops were increasing (with various shares of individual crops from this group), while the areas under sugar beet were exceptionally fluctuating. The Republic of Serbia is one of the largest producers of oilseed crops in Europe. Sunflower prevails, but the most significant rise is witnessed in the production of

soy and oil seed rape. The largest areas under oilseed crops are located in AP Vojvodini (94%). The reason for this is the favorable climate and soil conditions, processing capacity and developed network of suppliers and buyers.

The Republic of Serbia is the largest regional producer of vegetables. In the last several years, vegetables have been grown on the area of over 155 thousand hectares, of which about 77 thousand hectares under potatoes. The most commonly grown vegetables are medium early and medium late vegetables, although the conditions are also good for growing of certain early and late vegetables.

3.3.2. Livestock Production

The share of livestock production by value is about 33%, which is low considering the available land and its structure.

The overall production of meat in the Republic of Serbia has edged up in the last decade, reaching the volumes of up to 480 thousand tons. The situation varies a great deal between types of meat: while the production of baby beef is continuing its downward trend (down by 15% over ten years), the production of lamb and particularly poultry meat is exhibiting a dynamic upward trend of about 50% each. Such trends are caused by a set of factors, such as: the impact of weather on the production and price of animal feed, decline in domestic demand for quality meats, inability to export pork, etc. In addition, the production of meat has not been in the agricultural incentive system for a long time, which has had an additional adverse effect on the development of such production and losing already conquered markets.

3.4. Energy Consumption

In 2012, the Republic of Serbia produced 10.774 Mtoe of primary energy [19]. This level of production met over 70 % of the total primary energy needs. The structure of domestic primary energy production is as follows: production of coal amounts to 7.277 Mtoe of total domestic primary energy production, and the rest is the production of crude oil and natural gas, utilization of the hydro-potential and wind and solar energy, production of firewood and geothermal energy.

The overall consumption of primary energy in 2012 was 14.526 Mtoe. Serbian net import dependency in 2012 was 27.68 %. In 2012, the largest imports were those of crude oil and oil products at 51%, natural gas at 29%, coal at 10%, etc. The total final energy consumption in Serbia in 2012 amounted to 8.791 Mtoe, of which 0.278 Mtoe was for non-energy purposes, while the final energy consumption for energy purposes was 8.512Mtoe.

By consumption sector, final energy was used mostly in the household sector - 38%, then industry - 28%, transport - 21%, while other sectors had a 13% share of final consumption. On the other hand, in terms of the share of energy sources in final energy consumption, oil dominates with 31% together with electricity with 27%, followed by coal with 11%, natural gas with 11 %, heat with 8%, while renewable energy sources (firewood) have a 12% share.

The share of renewable energy sources in heating and cooling is calculated by dividing gross final energy consumption from renewable sources in the heating and cooling sector (as stipulated in Article 5(1)(b) and in Article 5(4) of Directive 2009/28/EC) with gross final energy consumption for heating and cooling - Table 6. Gross final energy consumption was calculated in accordance with Article 2 of Directive 2009/28/EC as the total final energy consumed for energy purposes in industry, transport, households, services including public services, agriculture, forestry and fisheries, including the consumption of electricity and heat by the energy branch for electricity and heat production, and including losses of electricity and heat in distribution and transmission – Table 7.

Table 6 – RES share by sector (electricity, heating and cooling, transport)

	Unit	2012	2013
RES – heating and cooling	[%]	23.32	21.86
RES – electricity		38.36	37.81
RES – transport*		0	0
RES – total share in GFEC		20.27	19.10
of which from cooperation mechanisms		0	0
surplus envisaged for cooperation mechanisms		0	0

Table 7 – Calculation of each sector's contribution in RES use to GFEC

	Unit	2012	2013
(A) GFEC from RES in the cooling and heating sector	[ktoe]	1031	1034
(B) GFEC from RES in the electricity generation sector		880	880
(V) GFEC from RES in the transport sector*		0	0
(G) Total RES consumption (estimated surplus with respect to the target)		1911	1914
(D) Transfers of RES to EU member states		0	0
(Đ) Transfers of RES from other EnC and third countries		0	0
(E) RES consumption adjusted for target (D)-(E)+(F)		1911	1914

* Quantities of biofuel on the market cannot be presented as RES contribution to the transport sector as there is no evidence that the sustainability criteria are met. Only after all the required biofuel related implementing legislation is adopted, the presentation of such data in the reports will be possible

The production and consumption of solid biomass includes the production and consumption of firewood, pellets and briquettes for energy purposes for heating. In 2013, biodiesel imports were reported in the amount of 8371 t. Such biofuel quantity is included in the balance of oil and oil products. Article 5(3) of Directive 2009/28/EC stipulates that biofuels and bioliquids that do not fulfill the sustainability criteria set out in Article 17(2) to (6) of the Directive shall not be taken into account when calculating the

share of energy from renewable sources. Considering that the implementing legislation defining sustainability criteria and their verification has not been adopted yet, the above amount of biofuel cannot be shown for the purposes of compliance with the RES target in the transport sector. On the basis of data from the Privileged Electricity Producer Register [http://www.mre.gov.rs/doc/registar28.11.html], in the period 2009-2015 (from the moment the first Decree on incentive measures for privileged electricity producers) new plants for electricity generation from RES have been built with the total installed power of 45 MW, as follows

- 45 small hydropower plants of the total installed power of about 33.5 MW;
- 72 solar power plants of 6.7 MW;
- One wind power plant of 0.5 MW (five wind power plants have a temporary status of privileged producer with total power of 45 MW),
- five biogas power plants with total power of about 4.1 MW.

4. Methodology

The estimate of available biomass resources in a region/area can be viewed as a string of successive activities, beginning with identification of agricultural activities in terms of plantations of particular cultures, their level of production/yield, through to the final calculation of net biomass potential. However, in some cases, when reliable data exists, the estimate may start at a higher level, obtaining the relevant data in this manner. For instance, by applying one of the sustainability criteria, which can be found in literature, and as such adopted as a coefficient of direct conversion to the level of biomass potential

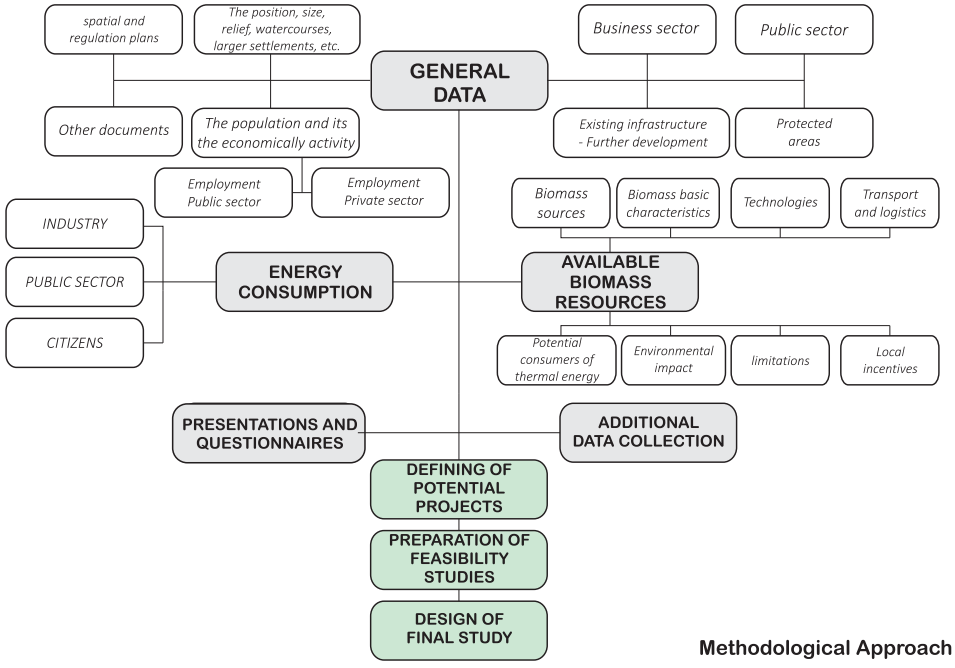


Figure 4 – Methodology approach

The total quantity of biodegradable fraction of products, wastes and residues of biological origin from agriculture was estimated using the latest statistical data on the production of each crop respectively, using coefficients that indicate the ratio between wastes and residues of biological origin and the main product. The value of theoretical energy potential at the annual level $E_{CA_{i,j}}$[toe], in the Srem District is equal to the following:

$$\sum_{i,j} E_{CA_{i,j}} = c_i \cdot P_{i,j} \cdot H_i \cdot 2{,}38846 \cdot 10^{-5}$$

- c_i[t/t] – value of ratio between wastes/residues and main product expressed in tons per ton;
- $P_{i,j}$[t] – annual production of the main product -i grown in the municipality -j of the Srem District;
- H_i [kJ/kg] – lower calorific value of wastes /residues of biological origin of the product - i;
- 1 kJ = $2{,}38846 \cdot 10^{-8}$toe.

The assessment of biomass use for energy purposes further requires the application of an integrated approach, where in addition to economic criteria social environmental and energy needs/consumption criteria must be included. For the evaluation of validity of implementing such a project at the local level, the Methodology - Figure 4, requires the knowledge of the following available biomass resources:

- Environmental protection at the local level, protected areas at the local level, specific ecological requirements, topography, climate conditions;
- **Agriculture:** overall statistics of the region/area in terms of agricultural production, including basic information on major crops and indicative average farm size **(quantity of available agricultural biomass to be used for energy purposes)**;
- **Forestry:** general information about the size of plantation, type of forest, manner of forest management, and type of ownership **(quantity of available woody biomass to be used for energy purposes)**;
- **Industry:** wood processing: industrial plants that already operate on the municipal/district (e.g. sawmills, production of engineered wood, OSB and laminated board, hard board, particle board, MDF, joinery, parquet, paper production, etc.), indicative size of the above companies, manner of using residue generated in processing, existing pellet and briquette manufacturing plants **(quantity of available biodegradable wood waste)**;
- **Public enterprises and PUC:** municipal waste management: information about municipal solid waste, quantities of solid waste generated per capita, significance of organic fraction, what is the usual practice in waste management in the region (e.g. collecting, sorting), "green waste" (generation and collection);
- Any other **source of biomass** on the municipal/district territory.

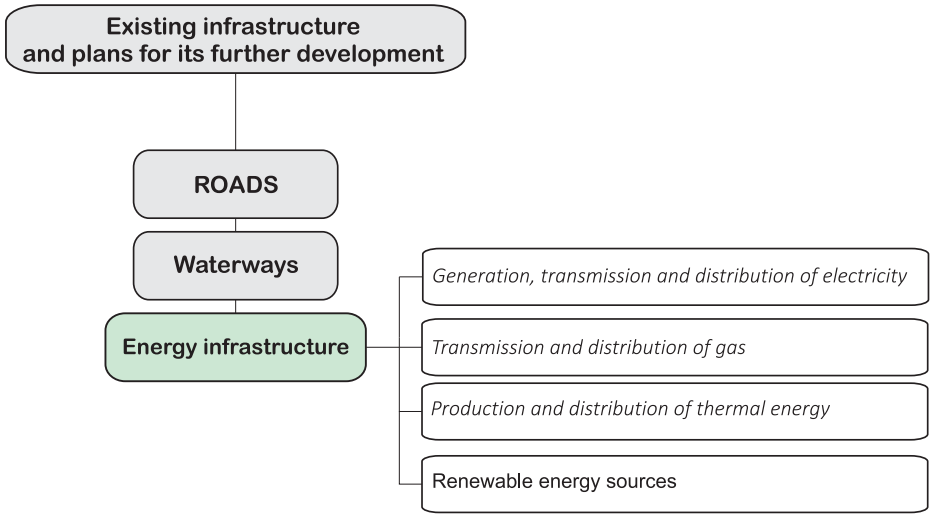


Figure 5 – Methodology: Infrastructure

The identification of available biomass is the first activity in the assessment algorithm for this type of projects. Such type of data can often be found in relevant sectoral documents. Integrative approach means knowing all the material facts relating to energy consumption at the local municipal/district level. Such approach involves the collection of data relating to the present energy consumption in the industry sector and/or public spending sector (public sector) and/or household consumption.

In addition, the data need to be collected on the existing energy infrastructure – Figure 5. This primarily means the collection of detailed information on the existing generation, transmission and distribution systems for electricity, natural gas and heat (district heating systems). Data on the existing energy systems using renewable energy sources, or any possible unrealized renewable source potential on the municipal/district territory also need to be collected. Special attention must be devoted to institutions – direct or indirect municipal/city budget users – Figure 6 (schools, hospitals, kindergartens, sport and recreational centers, homes for the elderly, homes for the children without parental care, theaters, cultural centers, etc.). The implementation of such type of projects in the above institutions may have multiple benefits through direct reduction of energy product produced outlays from the municipal/city budget), and/or improvement of the current working conditions (e.g. improved heating). Furthermore, public enterprises and public utility companies may also be very good "targets" for the implementation of this type of project. Data such as technical data relating to heating systems, type of energy products used, quantity of energy products used during the heating season, operating regime of the heating systems, are necessary for adequate evaluation of potential projects in the above institutions.

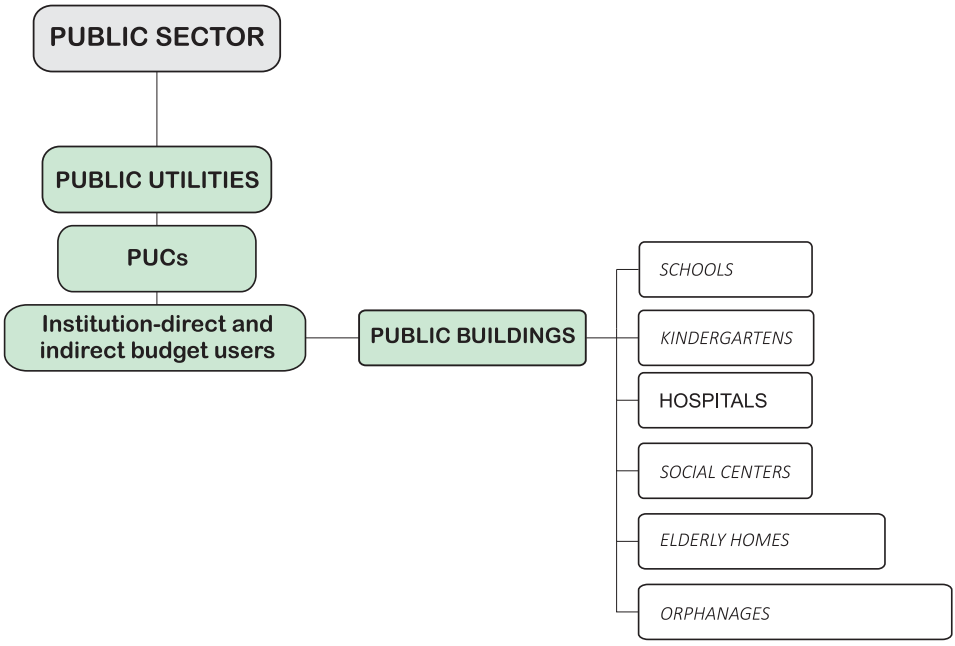


Figure 6 – Methodology: Public sector

Figure 7 shows branches within individual sectors that must be taken into account as potential sources for this type of projects. This primarily refers to the agricultural sector (cooperatives, large producers, farms), where at the same time one can find the potential for generation of heat and/or electricity on the one hand, and the need for increased consumption of energy on the other. In the forestry sector, as already stated above, the same is true of the wood processing industry.

Figure 8 shows the algorithm to be used to identify possible locations with certain potential identified in terms of using biomass as energy source for generating heat and/or electricity. In the initial stage, the potential project should be checked against the analysis of data about the location (accessibility of location) and basic economic indicators.

In this regard, it is necessary to collect data on all types of available biomass and their characteristics (calorific value, moisture content, hazardous substances), determine the distance between the location of available biomass and the potential location where the construction of a potential heat and/or electricity generation plant is planned. Furthermore, the operations of the chain of preparation and delivery of the available biomass also need to be provided for. Special attention should be given to the possibilities for storing the biomass, both at the site of the potential plant and the biomass collection site. If the above prerequisites are met, basic economic parameters need to be established, such as: unit price of biomass, its preparation and transport.

If the project concerns the reconstruction of the existing system with a change of energy source used, characteristics of operating regime of the previous system (number of hours of operation during the day, operating regime during weekends and public holidays). If the initial assessment indicates that the selected location is attractive, a more detailed analysis should ensue. Opportunity studies developed as part of this study actually covered the initial stage of possible project identification.

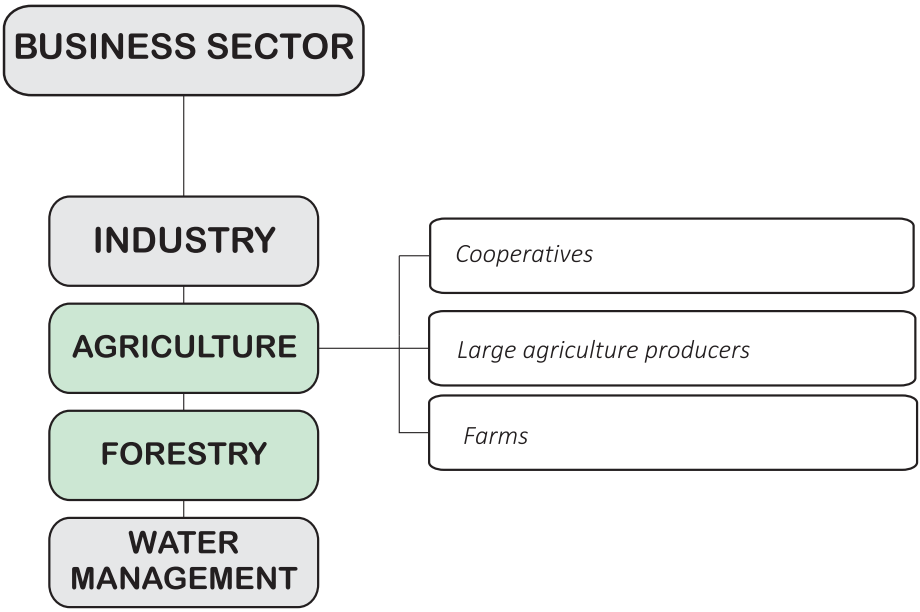


Figure 7 – Methodology: Business sector

The next step involves a much more detailed analysis and collection of much more information. This primarily relates to the present consumption (for the last three years) and defining the power duration curve, precise determination of future heat consumption and operating regime for the new plant and, on the basis of previously collected data, defining the plant power. The use of different energy sources, possible obstacles and restrictions regarding their use should be revisited, and decision on the selection of technical and technological solution should be made on the basis of alternatives analysis and thorough economic analysis.

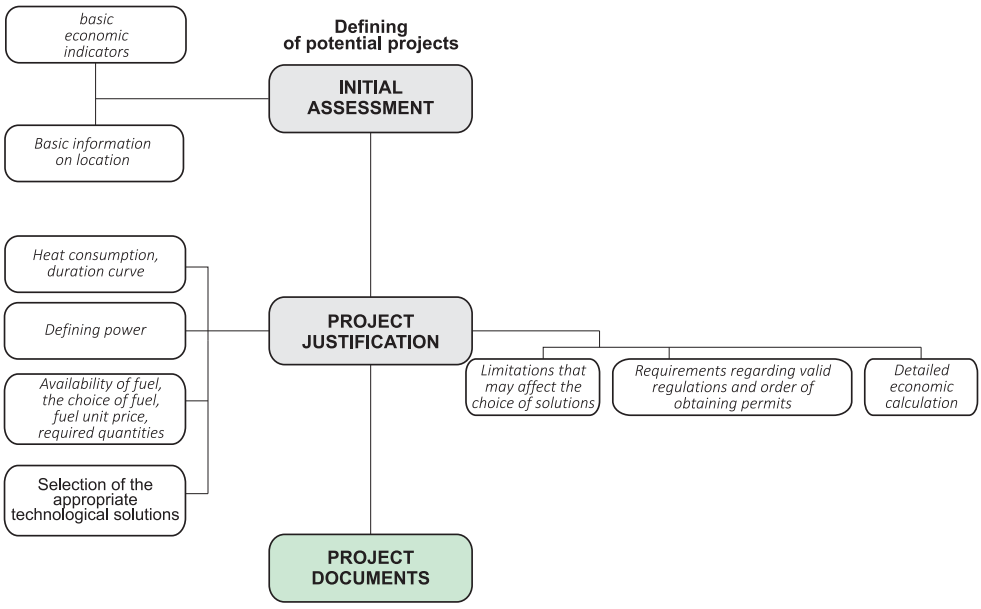


Figure 8 – Project definition algorithm

Technical documents

Under the current Law on Planning and Construction [21], technical documents shall be drafted as general design, conceptual design, preliminary design, design for issuing building permits, main design, detailed design, and as-built design.

Prior to initiating the preparation of technical documents for the construction of a facility (thermal power plant of 10 MW or more, combined electricity and heat generation facility with power generation of 10MW and more, and facilities for the production of power of 10 MW and more) which require, under Article 133 of the Law on Planning and Construction, a building permit issued by the competent ministry or AP, and which are financed with budget funds, preliminary work must be performed, the result of which is used to develop a preliminary feasibility study and a feasibility study.

For the construction of the above facilities (thermal power plant of 10 MW or more, combined electricity and heat generation facility with power generation of 10MW and more, and facilities for the production of power of 10 MW and more) in the cases where location requirements may be issued on the basis of an existing planning document, no pre-feasibility study is prepared with the general project design.

A pre-feasibility study establishes the spatial, environmental, social, financial, market and economic feasibility of the investment for alternatives defined in the general project design, on the basis of which a planning document is adopted, as well as the decision on

the justifiability of investment in activities on the preliminary design and preparation of the feasibility study. Under the Law on Planning and Construction [21], the pre-feasibility study shall include a general design. The general design shall specifically include the data on: macro-location of the facility; general layout of the facility; technical and technological concept of the facility; manner of providing infrastructure; possible alternative spatial and technical solutions from the aspect of fitting in the space; natural conditions; environmental impact assessment; engineering, geological, and geotechnical characteristics of the terrain from the aspect of establishing the general concept and justifiability of construction of the structure; exploratory works for preparation of the preliminary design; protection of natural and immovable cultural assets; functionality and rationality of the design.

4.1. Gender Equality

The Standing Conference of Towns and Municipalities (SCTM) recognizes the importance of gender equality for the development of local self-governments. Accordingly, it is envisaged that the project of "Mapping of the Municipal Spatial, Infrastructural, Resource Related and Logistic Prerequisites for Electricity and/or Heat Generation from Biomass in the Srem District" should include the analysis of gender aspects.

Gender analysis methodology is based on several assumptions, and is set within the framework provided by the methodology applied throughout the project by other members of the project team.

The initial assumption is that, due to gender based differences, men and women have different needs, interests, capacity and resources. These differences may affect the resource related and logistic prerequisites for electricity and/or heat generation from biomass in the Srem District. In addition, this activity, as innovative and developmental, provides a framework within which it is possible to work on the improvement of the position of women and promotion of gender equality, particularly with regard to:

- Participation in decision-making
- Sharing of knowledge and information
- Economic position

Gender analysis aims to establish the following:

1. Do women and men equally participate in the energy related decision-making process at the local level in the Srem District?
2. Will women and men, inhabitants of the Srem District municipalities equally benefit from the use of biomass – how will it affect the quality of life of women and men?
3. Will women and men be able to equally participate in the economic activities related to the production and use of biomass (farmers, public enterprise employees, citizens – energy consumers, etc.)?

The analysis includes the overview of national policies and normative framework, as well as national goals in the field of gender equality; general data on socio-economic position of women and men in Serbia; socio-economic data on the position of women and men at the local level; identification of gender nominated by local government for more detailed examination of potential and prerequisites (for example, public building heating with energy generated from biomass).

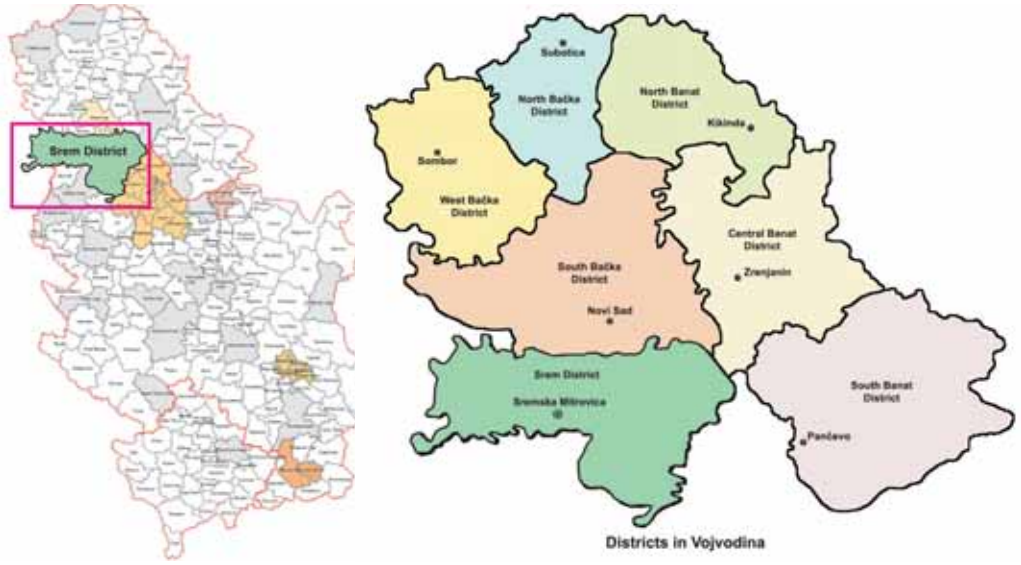
Among the multitude of methodology frameworks for gender analysis (Harvard, Moser, GIA models), the 4 R method was selected, which includes the examination of the following:

- participation/representation of women and men
- allocation of resources (including knowledge, information, energy)
- identification of gender patterns and their impact on the project
- recommendations for improving gender equality in the field of energy management

In addition to the data from the existing sources, municipalities in the Srem District provided the data on the position of women, their representation in public enterprises, participation in project eams and working meetings, target group at the municipal level.

5. The Srem District

The Srem Administrative District is located in the western part of the Republic of Serbia, in the the Autonomous Province of Vojvodina. It was named after the Srem geographical area, the largest part of which lies within the boundaries of the district – Figure 9.



a) in the Republic of Serbia b) in AP Vojvodina

Figure 9 – Position of the Srem District

5.1. Background Information

The Srem District covers a small part of Mačva. The south border of the district follows the river Sava, and only in its middle part does it stretch across it and covers the northernmost part of Mačva. To the south-east, the border traverses Srem, leaving its easternmost part to the City of Belgrade. It has a natural border - the Danube - with

Banat to the east. The northern border, although leaving the northern part of Srem in the South Bačka District, is also natural as it stretches through the middle of Fruška Gora bringing the entire south side of the mountain into the District. The western border is at the same time the state border with the Republic of Croatia. It is very irregular and cuts across several natural "borders" or barriers, like the river Bosut or Studva.

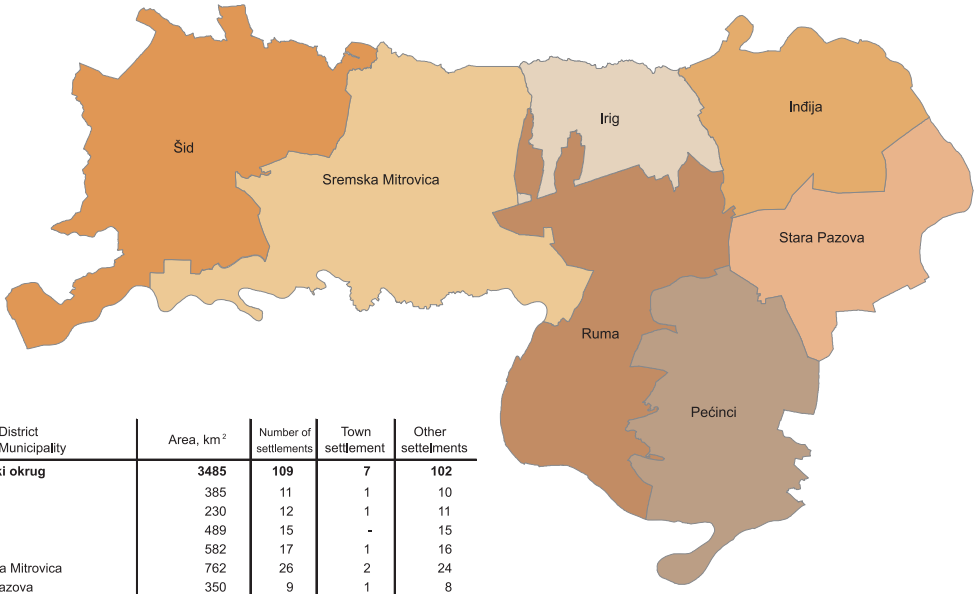
5.1.1. Location, surface area, watercourses, populated settlements

The Srem District covers the area of 3,486 km^2 and a population of 312,278 (2011 Census). The seat of the District is in the City of Sremska Mitrovica. The District includes the City of Sremska Mitrovica and municipalities of Šid, Inđija, Irig, Ruma, Stara Pazova, and Pećinci. The administrative division of the District is shown in Figure 10. The total number of settlements in the District is 109, of which 7 are urban and 102 are rural. The average population density is 89.2/km^2. Table 8 shows the basic administrative data about the District and municipalities.

Table 8 – Srem District – basic administrative data

District City - Municipality	Total area [km^2]	Agricultural land [%]	Number of settlements	Population as at 30/06/2012		No. of cadastral municipalities
				Total	per 1 km^2	
Srem District	3.485	73.1	109	310,418	89	107
Inđija	385	85.5	11	47,235	123	9
Irig	230	75.7	12	10,764	47	14
Pećinci	489	70.8	15	19,711	40	15
Ruma	582	74.4	17	53,828	92	18
Sremska Mitrovica	762	73.4	26	79,385	104	23
Stara Pazova	350	83.9	9	65,618	187	9
Šid	687	60.1	19	33,877	49	19

The area has an exceptionally good geostrategic position considering it is located close to the two most important and largest business centers in Serbia: Belgrade and Novi Sad. Srem is directly connected with Central and West, as well as South Europe by road and railway corridors



District Municipality	Area, km²	Number of settlements	Town settlement	Other settelments
Sremski okrug	**3485**	**109**	**7**	**102**
Inđija	385	11	1	10
Irig	230	12	1	11
Pećinci	489	15	-	15
Ruma	582	17	1	16
Sremska Mitrovica	762	26	2	24
Stara Pazova	350	9	1	8
Šid	687	19	1	18

Figure 10 – Administrative division of the Srem District

5.2. Spatial and Regulation Plans

The Spatial Plan of the Republic of Serbia from 2010 to 2020 [20], is an umbrella law setting the long-term basis of the organization, development, use and protection of the Republic of Serbia space for the purposes of harmonizing economic and social development with the natural, environmental and cultural potentials and restrictions in its territory. The enactment of the Law on the Spatial Plan of the Republic of Serbia from 2010 to 2020 gives force to Article 58 of the Law on Planning and Construction [21] on the obligation to develop the Program of Implementation of Spatial Plan of the Republic of Serbia [22]. The same law sets the time limit for the development of the Implementation program of one year from coming into force of the Plan. The Regional Spatial Plan was developed on the basis of the "Decision on the Development of the Regional Spatial Plan of APV", adopted by the Assembly of the Autonomous Province of Vojvodina in its session held in December 2009. The area for which the Regional Spatial Plan [23] was adopted covers the territory of the Autonomous Province of Vojvodina comprising territories of local government units in its geographical area (Bačka, Banat and Srem).

The Spatial Plan is elaborated through regional spatial plans, spatial plans for special purpose areas, spatial plans for the areas specified in the Spatial Plan, spatial plans of local

self-government units, urban plans, development programs and plans, and implementing legislation and general acts. Spatial plans, as strategic planning documents representing the basis for sptial development of a territory, have been adopted for all Srem District municipalities, as follows:

- Spatial Plan of the Municipality of Inđija, JP Zavod za urbanizam Vojvodine (PE Planning Institute of Vojvodina) – Novi Sad, 2008, [24];
- Spatial Plan of the Municipality of Irig, JP Zavod za urbanizam Vojvodine – Novi Sad, 2011, [25];
- Spatial Plan of the Municipality of Pećinci, JP Zavod za urbanizam Vojvodine – Novi Sad, 2007, [26];
- Spatial Plan of the Municipality of Ruma, JP Zavod za urbanizam Vojvodine – Novi Sad, 2007, [27]
- Spatial Plan of the Municipality of Sremska Mitrovica, JP Direkcija za izgradnju Opštine (PE Construction directorate of the Municipality of) Sremska Mitrovica, 2009, [28];
- Spatial Plan of the Municipality of Stara Pazova, Javno urbanističko preduzeće (Public Planning Enterprise) Urbanizam, Stara Pazova, 2012, [29].
- Spatial Plan of the Municipality of Šid, JP Zavod za urbanizam Vojvodine – Novi Sad, 2010., [30];

The Spatial Plan for the Special Purpose Area of Fruška Gora until 2022 [31] was adopted in 2004 and is of importance for the Srem District considering it refers to the parts of municipalities Irig, Inđija, Sremska Mitrovica, Šid, and Ruma.

The area of the Fruška Gora National Park as the Category 1 natural value is designated for 1st, 2nd, and 3rd degree of protection:

- The areas under the 1st degree of protection exclude any type of use and activity except scientific research and the activities preventing degradation.
- The areas under the 2nd degree of protection are the areas in endangered and important spaces with measures of strictly controlled use where permitted activities are those on improvement and presentation of natural values.
- The areas under the 3rd degree of protection are those with certain restricted use and controlled activities in accordance with the National Park functions, traditional economic activities and housing. At tourist and recreational sites, degraded areas, reservoirs, etc. activities such as construction are possible.

5.3. Legislative Framework

The Legislative framework for the energy sector is provided in the Energy Law [32] as the umbrella law. In March 2013, the Law on the Efficient Use of Energy was adopted [33]. The National Renewable Energy Action Plan (NREAP) [34], is the document setting the targets of use of renewable energy sources until 2020, as well as the manner of their achievement. Among other things, its aim is to enhance investments into the field of renewable energy sources.

Under Article 20 of the Treaty Establishing the Energy Community [35] and Law on the Ratification of the Treaty Establishing the Energy Community [36], the Republic of Serbia the Republic of Serbia accepted the commitment to apply European Directives in the field of renewable energy sources – Directive 2001/77/EC for the promotion of electricity from renewable energy sources and the Directive 2003/30/EC on the promotion of biofuels or other fuels produced from renewable energy sources for transport. Since 2009 the said Directives were gradually replaced and in January 2012 they were repealed by a new Directive 2009/28/EC of the European Parliament and Council, dated 23 April 2009, on the promotion of the use of energy from renewable sources and amendments [3].

In accordance with Directive 2009/28/EC and Decision of the Ministerial Council of the Energy Community dated 18. oktobra 2012 (D/2012/04/MC – EnC) [37], a very ambitious binding target was set for the Republic of Serbia, amounting to 27% of renewable energy sources in its gross final energy consumption in 2020. This same Decision specifies that the National Renewable Energy Action Plan of the Republic of Serbia should be prepared in compliance with the adopted template for the preparation of this document specified in the Decision 2009/548/EC and submitted to the Energy Community Secretariat. In the period 2013 – 2015 a whole range of programs and bylaws were adopted in the field of renewable energy sources. The List of laws and implementing legislation relating to the field of renewable energy is provided in Appendix 2 of this Study.

The Energy Law also defines basic terms in the field of renewable energy. Among others, it provides the following definitions:

- biomass is a biodegradable part of product, waste and remains of biological origin from agriculture (including plant and animal matters), forestry and biodegradable part of industrial and municipal waste;
- biofuels are liquid or gas transport fuels, produced from biomass;
- biofluid is liquid fluid for producing electric and thermal energy and heating and cooling energy, produced from biomass, except for transport

The use of renewable energy sources and procedures for obtaining appropriate licenses and approvals are regulated by legislation from different areas:

1. General international legislation - Law on the Ratification of the Treaty Establishing the Energy Community, as well as the legislation by way of which the Republic of Serbia undertook to comply with international regulations (Kyoto Protocol with the United Nations Framework Convention on Climate Change, Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, etc.);
2. Basic national legislation (defining the competences of ministries, autonomous provinces, on general administrative procedure, market supervision, waters, agriculture and rural development, etc.);
3. Energy related legislation (defining energy policy goals and manner of its implementation; requirements for the construction of new energy facilities; requirements and manner of performing energy activities; manner, conditions and incentives for energy generation from renewable sources and combined electricity and heat generation);
4. Legislation related to mining and geological exploration (regulating the exploitation of geothermal resources);
5. Spatial planning related legislation (pdefining the field of planning and construction of facilities, spatial plans, obtaining permits – location, building and occupancy permits), and
6. Environmental legislation (relating to environmental protection, environmental impact assessment procedure, contents of the environmental impact assessment study, participation of interested bodies and organization and public, supervision and other issues relevant for environmental impact assessment).

Energy activities – Licenses - Energy permit and approval

The Energy Law [32] defines, among others, the following energy activities: electricity generation; combined electricity and heat generation; heat generation; heat distribution; heat supply; biofuel production; biofluid production; mixing biofuels with the fuel of oil origin; trading in oil, oil products, biofuels and compressed natural gas.

Energy activity can be performed by a public enterprise, company or another legal entity or entrepreneur who has a license for performing the energy activity, unless otherwise prescrived by this law.

License

The license is issued upon application of the local legal entity or entrepreneur, as well as upon application by a foreign legal entity, only for performing the whole sale supply with electricity, in accordance with this law. The license is issued for each energy activity separately. For the following energy activities: electricity generation, combined electricity and

heat generation, and heat generation, the license is issued for a period of 30 years. License issuing is regulated in detail by Article 22 of the Energy Law [32]; among other things, the license may not be issued if:

- The applicant is not established or registered for the performance of energy activity for which the license is issued
- No occupancy permit has been issued for the energy facility, unless it falls under the regulation governing the construction of facilities that do not require occupancy permits;
- Energy facility and other devices, installations or plants necessary for performing the energy activity do not fulfill the conditions and requirements defined by technical regulations, regulations on energy efficiency,

The local government unit **issues licenses** for the following energy activities: generation, distribution and supply of heat, and maintains the register of issued licenses and records of producers of heat between 0.1 MW and 1 MW of power; by way of own regulation determines the terms and conditions of delivery and supply of heat to the buyers in its territory, rights and obligations of producers, distributers, suppliers and end-buyers of heat; issues regulations governing the manner of distribution of costs from the common measuring point in the heat connection station and the conditions and manner of maintaining the part of the system from the end of the distribution system to the end buyer, including his heating equipment; the rights and obligations of end-buyers, as well as terms and conditions for submitting and deciding on the end buyer's application for the termination of supply of heat; grants approval on the prices of heat and prescribes other terms and conditions for ensuring reliable and safe supply of buyers with heat, in accordance with the law [32].

The license is not required for the following energy activities:

- electricity generation in facilities with total approved power up to 1 MW, unless the same energy entity produces electricity in two or more energy facilities whose total approved power exceeds 1 MW, whether or not they are connected to the system through on or more connections;
- heat generation in facilities of total power up to 1 MWt and heat generation exclusively for own needs
- combined electricity and heat generation in thermal power plants – district heating plants in facilities of up to 1 MW of total approved electrical connection power and 1 MWt of total heat power as well as combined electricity and heat generation in exclusively for own needs

Energy permit

The construction of the following facilities requires a permit issued by the line Ministry (Ministry of Mining and Energy):

- facilities for electricity generation with power equal to or over 1 MW;

- facilities for combined electricity and heat generation in thermal power plants - district heating plants, in facilities with electricity power equal to or over 1 MW and with total heat power equal to or over 1 MWt;
- facilities for heat generation with power equal to or over 1 MWt;
- facilities for biofuel production with capacity of over 1000 tonnes per year

The energy permit is submitted together with the building permit application. The energy permit is not required for the construction of energy facilities built under the law regulating public-private partnership and concessions. Detailed procedure for the issuance of energy permit is available at the following webpage of the line Ministry (Ministry of Mining and Energy):
http://www.mre.gov.rs/latinica/energy-efikasnost-renewablei-izvori-procedure.php

Privileged electricity producers and incentive feed-in tariffs

Under the Decree on Conditions and Procedure for Acquiring the Status of Privileged Electricity Producer, the privileged electricity producer status may be acquired by legal entities or entrepreneurs engaged in energy activity of power generation in the following types of power plants:

1. biomass fired power plant;
2. biogas fired power plant;
3. power plant fired by biogas of animal origin;
4. landfill and sewage gas power plant
5. waste fired power plant

as well as in following power plants that are not subject matter of this study: hydro power plant with installed power up to 30 MW; hydro power plant using existing infrastructure with installed power up to 30 MW; wind power plant; solar power plant i.e. solar radiation power plant; geothermal power plant;

Biomass power plants are power plants using biodegradable waste materials from agricultural production processes, forestry and households, including: plants and plant matter, plant remains from agricultural production (straw, corn stalks, branches, seeds, shells), manure from farms, by-products of forest management activities (wood remains), biodegradable residues from food processing and wood industry which do not contain either hazardous substances or separated biodegradable fraction of municipal waste

Biogas power plants are power plants with one or more generators using gas from its facilities (reactors) formed by anaerobic process from biomass other than biomass of animal origin.

Landfill gas power plants are power plants using gas from municipal landfills.

Sewage gas power plants are power plants using gas formed by anaerobic processes in the plants for treatment of municipal waste water.

Waste fired power plants are power plants using any type of substance or objects listed as a waste (Q List) that have been or are intended to be discarded by the owner or that the owner is obligated to discard according to regulations that define methods of use of waste for energy production and respecting waste management hierarchy.

In the biomass fired power plant (1), the annual calorific value of primary fuel i.e. biomass must be at least 80% of total annual calorific value of consumed fuel. For power plants under (2), (3), (4) and (5) the calorific value of primary fuel i.e. used renewable energy source must be at least 90% of total annual calorific value of consumed fuel. fossil fuel, waste gas with organic fraction or other renewable energy source can be used as auxiliary fuel. Privileged electricity producer which conducts the activities of power production in a power plant under (1), (2), (3), (4), and (5) of the Decree, is obligated to keep a record of the primary fuel consumption (basic and auxiliary fuel) that contains data on amount and on average lower calorific value of consumed fuel.

The Decree on Incentive Measures for Privileged Electricity Producers provides for the following incentive measures:

- The incentive period of 12 years for each of the power plants of the privileged electricity producers which were commissioned less than 12 months before conclusion of the Power Purchase Agreement i.e. the 12 years incentive period reduced by difference between the year of concluding the Power Purchase Agreement and the year of commissioning of all the other privileged producers' power plants;
- Feed-in tariff at which the privileged producer is entitled to sell total amount of electricity generated during the incentive period to the Public Supplier;
- The right of privileged producer who had previously acquired temporary status of privileged electricity producer to sell total amount of electricity generated during the incentive period to the Public Supplier at feed-in tariff valid at the time of acquiring temporary status of privileged electricity producer;
- Taking balancing responsibility and balancing costs from privileged producers during the incentive period by the Public Supplier;
- Free of charge monthly notification of a privileged producer and Public Supplier on the electricity generation in the facility of the privileged producer metered by the relevant System Operator during the incentive period;
- The right of a privileged producer to conclude an Agreement with the Public Supplier after the incentive period on purchase of the total amount of produced electricity on market conditions prevailing on the organized electricity market in the Republic of Serbia

Incentive feed-in tariffs	Installed power P	Incentive feed-in tariff
	[MW]	[c€/kWh]
Biomass power plant	up to 1	13.26
	1-10	=13.82 - 0.56*P
	over 10	8.22
Biogas power plant	up to 0.2	15.66
	0.2-1	16.498 - 4.188*R
	over 1	12.31
Plant fired by biogas of animal origin		12.31
Landfill and sewage gas power plant		6.91

5.3.1. Local Incentives

The Srem District does not have any specific incentives for heat and or electricity generation from biomass.

5.3.2. Standardization

Technical specification (CEN/TS) for solid biomass were prepared in the EU in the period 2000- 2006, and subsequently upgraded to become standards. Most of these EN standards were taken over in original form and/or published/translated in the period between 2009 and 2014. The priority list of standards related to solid biofuels was created in close cooperation with Institute of Standardization of Serbia. Established Technical Committee for solid biofuels provided their technical expertise and adequate suggestions regarding terminology related to quality management systems of wood fuels according to the determinations of EN standards, EN plus system of wood fuels (pellets) as well as certification of quality of wood fuels, energy balances, appraisal of operational and investment costs with subsequent economic evaluation. The standards are published on the website of the Institute of Standardization of Serbia. GIZ DKTI programme "Development of a sustainable bioenergy market in Serbia EU" supported the translation of 12 EU harmonized standards [38] related to solid biofuels into Serbian language in order to enable production and utilization of solid biofuels in line with EU best practices.

5.4. Population and its Economic Activity

According to the 2011 Census, the Srem District has a total population of 312,278. The largest number of people live in Sremska Mitrovica (25.6% of the total district population), and Stara Pazova (21.1%), and the least in Irig (3.5%) and Pećinci (6.3%).

Table 9 – Economic activity of the Republic of Serbia and the Srem District population

District City-Municipality	Total	Economically active			Economically inactive	Number of employed persons per 1000 population*
		all	Perform occupation	Unemployed		
the Republic of Serbia	7.186.862	2.971.220	2.304.628	666.592	4.215.642	240
Srem District	312.278	126.206	98.385	27.821	186.072	183
Inđija	47.433	19.635	14.744	4.891	27.798	186
Irig	10.866	4.460	3.751	709	6.406	132
Pećinci	19.720	7.798	6.693	1.105	11.922	153
Ruma	54.339	21.074	16.166	4.908	33.265	173
Sremska Mitrovica	79.940	32.738	25.877	6.861	47.202	203
Stara Pazova	65.792	27.322	21.366	5.956	38.470	189
Šid	34.188	13.179	9.788	3.391	21.009	169

Source: SORS, Population Census 2011.
*as at 31/12/2012, publication Municipalities and Regions in the Republic of Serbia, SORS, 2013.

The overview of economic activity of the population in the District, given in table 9, shows that approximately 40% of population is economically active, and that the unemployment rate is 22%. These figures are somewhat more favorable than the Serbian average. By municipality, the share of economically active population is the largest in Stara Pazova (41.5%) and Inđija (41.4%), and the smallest in Šid (38,5%) and Ruma (38,8%).

5.4.1. Employment

Subseqent data on the number of employed persons show that the average for the municipalities in this district, 183 employed persons per 1,000 population, below the national average (240). By municipality, the largest number of employed persons under this criterion is in Stara Pazova (189) and Sremska Mitrovica (203), and the smallest in Irig (132) and Pećinci (153). Based on data from the 2011 Census percentage of employed women in Srem District is 44.9% which is lower by about 10% compared to the national average, with 45.9%. The largest proportion of women among the unemployed is in Sremska Mitrovica, and the smallest in Ruma and Sid. These differences can be further investigated by examining the dominant industries and largest employers in the municipalities.

By sectors, the largest number of employed persons in the district work in the processing industry (22.1%), or as entrepreneurs (self-employed persons) or are employed with them (22%). Other sectors with a large share are trade (10.2%), health care and social welfare (8.5%) and education (8.1%). All municipalities in the District have a similar sectoral structure of employed person, but the municipalities of Inđija, Irig and Ruma have a slightly higher number of entrepreneurs than persons employed in the processing industry.

5.5. Climate

The Srem District is characterized by continental climate, which is also dominant in the entire Pannonian Plain. The meteorological elements and events are shown on the basis of mean monthly, annual and maximum/minimum values measured at the meteorological station in Sremska Mitrovica between 1981-2010 – Table 10.

Air temperature is one of the most important climate elements as affect the intensity and volume of evaporation, air humidity, cloudiness, precipitation etc. depend on air and ground (soil, water, snow, etc.) temperatures. The difference between mean January and mean July temperature is 19.8^{O}C, which reconfirms the continental nature of this area climate. The annual mean air temperature is 11,3^{O}C. The mean temperature in the vegetation period is a favorable 18.0^{O}C – Table 10.

The annual trends in relative humidity are contrary to the annual trends in air temperature. That means that relative humidity is higher in the colder part of the year, and lower in the warmer part of the year. Measured annual values of relative humidity indicate moderate air humidity in this area. The average air humidity is 76 %, and above 68% on average in all months. The lowest average value for humidity is in May (68%), and the highest in December (88 %).

Cloudiness means refers to the fraction of sky obscured by clouds. December has the largest number of cloudy days (15), while July and August are characterized with the smallest number of cloudy days (3). Insolation is highest in the summer months and lowest during winter. Insolation depends on the duration of daylight, season and cloudiness (inversely proportional).

In Vojvodina, there are great variations in the amount of rainfall even between the measuring stations that are close to each other. The precipitation regime in the territory of Sremska Mitrovica municipality is central- European regime of precipitation pattern with the corresponding characteristics that include, among other things, unbalanced monthly distribution, and development of local summer depressions with storms and showers over months.

Table 10 – Monthly and annual means, minimum and maximum values of meteorological elements for the period 1981 – 2010													
Measuring station: Sremska Mitrovica, altitude: 82 m													
Geographic latitude φ:	45°01N				Geographic longitude λ:				19°33E				
Month:	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	**Yr.**
Temperature [°C]													
Mean daily maximum:	3.6	6.5	12.5	18.0	23.4	26.1	28.3	28.4	23.7	18.3	10.5	4.8	17.0
Mean daily minimum:	-3.1	-2.5	1.2	5.9	10.9	13.7	15.0	14.8	10.9	6.7	2.2	-1.6	6.2
Normal value:	0.1	1.6	6.4	11.8	17.2	19.9	21.5	21.2	16.6	11.7	5.8	1.4	11.3
Absolute maximum:	17.8	23.7	28.3	31.4	34.8	36.8	40.7	39.4	37.6	30.2	25.0	22.0	40.7
Absolute minimum:	-29.5	-22.5	-17.3	-7.8	0.0	4.1	6.4	5.8	1.4	-6.0	-13.5	-21.3	-29.5
Mean no. of days with frost :	23	19	11	2	0	0	0	0	0	2	9	18	84
Mean no. of tropical days:	0	0	0	0	2	6	12	11	2	0	0	0	34
Relative humidity [%]													
Average	87	81	73	69	68	71	71	71	75	78	85	88	76
Insolation													
Average	62.5	104.3	156.6	189.2	250.6	264.0	292.7	279.8	190.0	153.2	89.5	48.7	2081.1
Number of clear days	3	5	5	4	5	6	11	12	8	7	4	3	73
Number of cloudy days	14	10	9	8	6	5	3	3	6	7	11	15	97
Rainfall [mm]													
Mean monthly total	37.9	29.2	40.4	48.4	56.2	84.4	61.6	52.8	50.3	54.6	52.8	45.6	614.2
Maximum daily total	37.1	32.7	36.1	36.1	50.6	57.6	67.0	55.4	37.9	54.5	41.1	33.2	67.0
Mean no. of days w ≥0.1 mm	12	11	11	12	12	12	10	9	10	9	12	13	133
Mean no. of days w ≥10.0 mm	1	1	1	1	2	3	2	2	2	2	2	1	19
Weather (number of days with ....)													
Snow	7	7	3	1	0	0	0	0	0	0	2	6	26
Snow cover	12	9	3	0	0	0	0	0	0	0	2	7	33
Fog	6	4	1	1	1	1	1	2	2	4	5	7	34
Hail	0	0	0	0	0	0	0	0	0	0	0	0	1

Relative wind direction frequency and calm conditions in 1 per thousand and mean speed of wind [m/s]																	
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	C
Rel.frequency[‰]	34	31	54	128	107	67	26	18	19	21	28	69	94	102	59	52	92
Mean speed [m/s]	2.6	1.7	1.7	2.5	2.6	2.6	2.3	2	1.8	2	1.8	2	2.3	2.6	2.8	2.9	
Source: RHMS																	

The mean annual rainfall is 614.2 mm, with the rainiest month of June (84.4 mm) and the driest month of February (29.2). The rainfall in the vegetation period is on average 353.7 mm. Precipitation in the form of snow occur on average during 26 days a year in the period from November to April. For appears on average during 34 days, in all months but the greatest frequency in December.

Winds also have a marked impact on climate characteristics. On the basis of values for annual wind direction frequencies and calm conditions it can be concluded that the most frequent wind in this area is the wind blowing in the east-northeast direction (128 ‰) and the east wind (107), followed by the wind blowing in the west-northwest direction with 102 per thousand. The least frequent wind blows in the south-southeast direction with only 19 per thousand of annual distribution. The northwest wind has the

highest mean speed of 2.9 m/s, followed by the west wind with 2.8 m/s and north wind with 2.6 m/s. On the other end of the spectrum, the northeast wind has the lowest annual mean speed of 1.8 m/s.

5.6. Economy

The main driver of economic development of the Srem District, in addition to agriculture, is industry and small business (trades, small and medium-sized enterprises). Developed industries include metalworking, food processing, chemical processing, and leather, footwear and textile industries.

The Srem District also has capabilities for the production of building materials, and construction operations. The products include brick and other building material, and gravel and sand exploitation is also carried out. Construction operations include building construction, civil engineering construction, and specialized construction and specialist trades works.

In the services sector, the most prominent are trade, catering and tourism. Trade mostly refers to companies and sole proprietorships that trade in the domestic market. There are numerous and varied catering facilities that, in addition to catering, also offer tourist services. The wealth of Fruška Gora and marshes in Srem offers excellent conditions for breeding various species of game. Obedska Bara and Bara Zasavica are water, flora and fauna conservation areas, and are unique in Europe and the world. The long and rich history of the Srem region enables constant development of tourist offer.

With the aim of developing business activities, most municipalities formed industrial zones as sites for capital investment. Forming of such zones enabled the construction of ne capacity and the possibility to locate production facilities away from central and residential settlement zones, which primarily reflects on the quality of the environment in the settlements and the quality of working and production conditions.

5.6.1. Industry

Metal processing industry is a developed segment of the business structure and comprises: vehicles, agricultural and construction machinery, servomechanisms, hydraulics, engine valves, wheels, butane gas canisters, boilers, processing industry equipment, equipment for silos and railways, nails, bolts, and other hardware. In addition to meeting the needs of the domestic market, these products are also exported to EU countries.

Relying on abundant primary agricultural production there developed a strong food processing industry. Factories have the capacity to produce high standard final products so that they can meet the demand on both the domestic and foreign markets. The

main food processing industry products are pasta, sugar, edible oil, corn products, frozen and marinated vegetables, fruit pulp, brandy and wine, meat and meet products, dairy products.

An important place in the processing industry is held by processing of raw hide, production of footwear, accessories, garments, knitwear, and personal protective equipment. The production facilities have large capacity and traditionally export to foreign markets. Also developed is cottage industry, carpet making, tapestry and curtains, which is exported for the most part.

Srem is rich in forests, particularly oak, which is well known throughout the world for its fine quality. The region has a centuries' long tradition in the production and growing of trees, and wood processing is one of the oldest industries in Srem, and is still very developed. The products are dimensional lumber, parquet, veneer and boards, and are exported to all European countries. In addition to primary processing, manufacturing of classic and antique style furniture and accessories, and equipment for buildings are also very developed.

5.6.2. Agriculture

Agricultural land covers 73.1% of the Srem District area, or approximately 2,500 km2. The percentage varies between municipalities, from the minimum of 60.1% in Šid and 70.8% in Irig, to the maximum share of 83.9% in Stara Pazova and 85.5% in Inđija. The total utilized agricultural area is 229,195 ha. Compared to the total available agricultural area, the utilization rate is about 89%. Of those 213,715 ha is arable land, 4,899 ha are fruit and berry plantations, 1,172 ha vineyards, and 7,409 ha are meadows and pastures.

As for of types of soil, the most prevailing is the chernozem (48%), alluvial and deluvial soil (13%), brown earth (10%), and black meadow soil (9%), [39]. Chernozem is considered the most favorable type of soil for agricultural production, due to its water characteristics and physical and chemical properties. Climate has a decisive influence of its formation. In the creation of chernozem, humus accumulates and forms a humus horizon of varying depths. According to the current soil classification, black meadow soil is also a type of chernozhem. Brown earth in Srem is mostly agricultural land. Their humus- accumulation horizon is characterized with very favorable water and air regimes, as a result of the ratio between large, medium and fine pores. These are well leached and warm soils. Brown earth soils are suitable for crop farming and growing of vegetables, fruits, viticulture. Alluvial soil is created by depositing material of varying mineral and mechanical composition by flooding rivers. It has marked layers.. Due to its fertility and proximity of water for irrigation, these are highly fertile soils suitable primarily for vegetable farming.

According to the data from the 2012 Census of Agriculture, the total number of agricultural holdings in the Srem District is 29,313. The average size of utilized agricultural area per holding in the District is 7.82 ha. With regard to agricultural holding size,

majority hold less than ten hectares (24,741), while larger ones are relatively few (474 holdings have between 50 to 100 ha, and 186 agricultural holdings have more than 100 ha of arable land). According to the 2012 Census, women are holders of 17% of farms, while according to data from 2008 28% of households were registered to women, which means that their share decreased dramatically. Women are heads of households with less surface area of arable land; only 10.7% of households with more than 50ha is registered to women, compared to 22% of households with 1 hectare of land or less.



Figure 11 – Average sowing structure in the Srem District, [40]

Among the agricultural crops, the most common are maize (119,221 ha), wheat (35,314 ha), soy (23,546 ha), fodder crops (9,279 ha), sunflower (6,923 ha), fruit and berry plantations (5,153 ha), barley (4,845 ha), vegetables (2,342 ha), vineyards (1,172 ha), oilseed rape (1,005 ha), [13]. The data collected during the Census of Agriculture generally match the average sowing structure shown in Figure 11.

Absolute and relative yields for different crops at the level of the Srem District are shown in Table 11. The distribution of sowed areas and yields by municipality are provided in detail in the chapters devoted to individual municipalities.

Table 11 – Crop yields in the Srem District [41]

Wheat	Yield	Total	[t]	157,191
		Companies and cooperatives		33,079
		Family holdings		124,112
	Average yield	Companies and cooperatives	[kg/ha]	6,013
		Family holdings		4,163
Maize	Yield	Total	[t]	286,199
		Companies and cooperatives		29,093
		Family holdings		257,106
	Average yield	Companies and cooperatives	[kg/ha]	3,097
		Family holdings		2,341

Table 11 – Crop yields in the Srem District [41]				
Industrial and vegetable crops	Sugar beet	Yield	[t]	319,640
		Average yield, kg/ha	[kg/ha]	31,224
	Sunflower	Yield	[t]	13,236
		Average yield	[kg/ha]	1,912
	Soy	Yield	[t]	32,405
		Average yield	[kg/ha]	1,376
	Oilseed rape	Yield	[t]	2,724
		Average yield	[kg/ha]	2,710
	Barley	Yield	[t]	18,300
		Average yield	[kg/ha]	3,777
Fodder crops	Clover	Yield	[t]	6,430
		Average yield	[kg/ha]	4,465
	Lucerne	Yield	[t]	32,624
		Average yield	[kg/ha]	4,168
	Meadows	Yield	[t]	2,274
		Average yield	[kg/ha]	576
	Pastures	Yield	[t]	2,816
		Average yield	[kg/ha]	351
Fruit and grapes	Apples	Number of productive trees	[ком.]	1,264,750
		Yield, t	[t]	13,645
		Yield per tree	[kg/tree]	10.8
	Plums	Number of productive trees	[pcs]	1,049,757
		Yield, t	[t]	8,755
		Yield per tree, kg	[kg/tree]	8.3
	Vineyards	Number of productive vines	[pcs.]	11,797,000
		Yield, t	[t]	15,604
		Yield per vine kg	[kg/vine]	1.3

According to the 2012 Census of Agriculture, a total of 23,332 agricultural holdings breed livestock and has 123,104 livestock units. These holdings are characterized by relatively small volume of production. There are only 48 holdings with over five hundred livestock units, and only 7 households have more than five hundred livestock units.

Table 12 shows the structure of the livestock fund in the Srem District u 2012.

Table 12 – Livestock fund in the Srem District [41]	
Bovine	36,840
Pigs	327,953
Sheep	41,895
Poultry	1,216,084
Horses	984

5.6.3. Forestry

Srem forest area comprises:

1. **State forests covered by forest management units:** Draganovci-Lopadin Dubrave-Kablarovac-Đepuš, Neprečava-Varoš-Lazarica, Blata-Malovanci, Raškovica-Smogvica, Vinična-Žeravinac-Puk, Rađenovci-Novi, Radinska-Vranjak, Kućine-Naklo-Klještavica, Smogva-Grabova Greda, Varadin-Županja, Vratična-Cret Carevina, Banov Brod-Martinački poloj-Zasavica-Stara Rača, Dobreč-Vukoder Debeljak-Galovača, Senjajske bare II -Karakuša, Grabovačko-Vitojevačko ostrvo Vitojevački atar, Baradinci-Pavlaka-Vučkovac, Senjajske bare and -Krstac, Jalija-Leget Turjan, Visoka šuma-Lošinci, Matijevica-Kadionica, Kupinske grede, Jasenska Belilo, Kupinski kut, Čenjin - Obreške širine, Krčedinska ada, forest management unit Bališa, located on the territory of Šid municipality and CM Molovin;
2. **Unregulated state forests managed by forest management companies**;
3. **State- (socially-)owned forests previously managed by socially-owned legal entities**, which are located on the territory of the City of Sremska Mitrovica and municipalities: Šid, Beočin, Irig, Ruma, Pećinci, Stara Pazova, Inđija, and Sremski Karlovci;
4. **Privately owned forests on the territory of the City of Sremska Mitrovica and municipalities:** Šid, Beočin, Irig, Ruma, Pećinci, Stara Pazova, Inđija, and Sremski Karlovci.

The total forest and wooded land in the Srem District amounts to 57,195.32 ha – Figure 12, or about 16.5 % of the total district area – Table 13. Compared to rates elsewhere in Vojvodina (6.37%), this represents a high level of forest cover, although the situation varies between municipalities. Šid has the largest forest coverage in the district, while Stara Pazova has the smalles forest and wooded area.

Table 13 – Forests and wooded land in the Srem District municipalities

Municipality	Total forest and wooded land [ha]	Share of wooded land [%]
Inđija	1,225.76	3.19%
Irig	4,478.24	19.46%
Pećinci	10,506.20	21.50%
Ruma	8,345.14	14.5%
Sremska Mitrovica	1,0837	14.3%
Stara Pazova	127	< 1%
Šid	21,675.98	31.55%
TOTAL	57,195.32	16.5%

Data source: Republic Geodetic Institute, Municipal Real Property Cadastre Offices

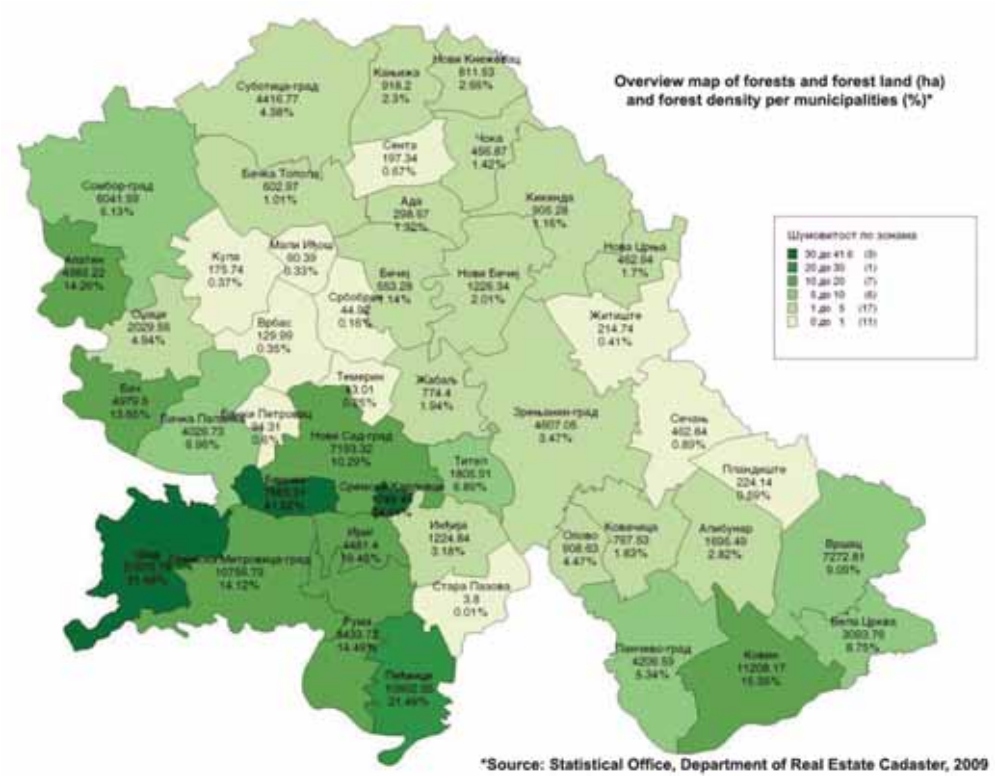


Figure 12 – Map of forests and wooded land and forest coverage by AP Vojvodina municipalities [23]

Šumsko Gazdinstvo (forest holding) Sremska Mitrovica manages state forests and wooded areas in the Srem forest region. The company operates as part of the public enterprise Vojvodinašume. Šumsko Gazdinstvo Sremska Mitrovica has 4 forest administrations: Višnjićevo, Kupinovo, Morović and Klenak. The total forest and wooded land managed by this forest holding is 38,810.28 ha, and the growing stock amounts to 11,618,459 m3.

There are many tree species that are registered on the territory of Srem forest area. Due to the conditions in the habitat, dominating species are pedunculate oak, narrow leaved ash, and hornbeam, while other species are less present, some only symbolically. Despite the domination of autochthonous species, which is favorable in terms of biological stability of these forests, there is a problem of introduced species, particularly the cloned and cultivated species of euro-american poplars, the plantations of which were often established in narrow leaved ash and pedunculate oak habitats, which results in poor health and low productivity. Detailed information on the structure and characteristic of growing stock owned by ŠG (FH) Sremska Mitrovica by type of tree are shown in Table 14.

Table 14 – Structure and characteristics of the growing stock of ŠG Sremska Mitrovica [42]			
Species	**Volume**	**Increment**	**Felling quantity**
	[m3]		
EAT	1,112,579.00	66,767.00	95,798.00
Willow	55,763.70	2,286.00	4,030.00
Sliver-leaf poplar	85,029.50	2,358.00	2,426.00
Other soft broad-leaved trees	102,610.60	2,481.00	1,118.00
Pedunculate oak	6,228,833.70	115,745.00	56,225.00
Narrow-leaved ash	2,259,806.30	43,800.00	22,655.00
Black lcust	103,073.20	3,757.00	7,450.00
Bitter oak	458,785.20	10,060.00	4,908.00
Hornbeam	808,134.90	16,524.00	13,989.00
White ash	17,579.40	461.00	1,037.00
Black walnut	33,471.80	893.00	436.00
Other hard broad-leaved trees	352,787.20	9,825.00	6,012.00
Other conifers	4.80	-	-
Total:	**11,618,459.00**	**274,956.00**	**216,122.00**

A large portion of forest land in this District (about 15,000 ha) is located within the boundaries of the Furska Gora National Park. Forest management complies with the provisions of the Spatial Plan for the Special Purpose Area of Fruška Gora and specified protection regimes and measures. The National Park Fruška Gora is managed by the Javno Preduzeće (public enterprise) Nacionalni Park Fruška Gora. Forests are divided into 14 forest management units, and management is organized into 5 protection and improvement offices, of which three (Vrdnik, Ležimir, and Erdevik) are located in Srem. By origin, the most prevailing forests are coppice forests (over 80%), and by preservation status, more than 85% are well preserved stands. Fruška Gora forests are mostly mixed (79 %), with over 50 tree species. The economic potential of forests and wooded land in the National Park Fruška Gora lies in its timber intended for the uses specified in planning documents, as well as in non-afforested land.

The remaining forests and wooded land is privately owned and characterized by small parcels of forested land.

The data on forested areas in the Srem District for 2012 are given in Table 15, showing that the areas under forest cover a total of 48,758.42 ha. Cut timber amounts to 240,055 m3 of hardwood, of which 46% is technical wood, and only 46 m3 of softwood, [41].

Table 15 – Forested areas and cut timber					
Municipality	**Areas under forests**	**Total**		**Technical wood**	
		Hardwood	**Soft wood**	**Hardwood**	**Soft wood**
		[m3]		**[%]**	
Srem area	48,758.42	240,055	163	46	100
Inđija	487.80	1,282	-	58	-
Irig	2,727.98	5,549	5	18	100
Pećinci	8,153.88	70,863	-	60	-
Ruma	6,237.51	50,878	-	46	-
Sremska Mitrovica	9,881.03	26,636	-	43	-
Stara Pazova	127.00	-	-	-	-
Šid	21,143.22	84,847	37	100	-

5.6.4. Water Management

The borders of Srem to the south and to the east are defined by the rivers Sava and Danube. In this area, they possess all the features of expressly lowland rivers. Other natural waterways of the area comprise the streams of Fruška Gora and the river Bosut.

On the southern slope of Fruška Gora, in the basin of the Sava, there are 30 streams of different lengths ranging from less than 2 kilometers to 27 kilometers, with the longest ones being: Međeš (27 km), Šelevrenac (26 km) Kudoš (25 km), Manđelos (23 km), Jelence (21 km), Borkovac (20 km), Čikas (19 km) and Šidina (18 km). The Fruška Gora streams in the Danube river basin are typically shorter, and there are 53 of them. The longest one is Patka-Budovar near Krčedin (52 km). Many Fruška Gora streams have standing water, some dive after a few kilometers and start flowing underground, and the streambeds are often waterlogged and marshy areas with very shallow aquifers.

The Bosut is a left tributary of the Sava river, which is fed by the Bić stream near Cerna and then flows though western Srem almost in parallel to the Sava for around 180 km. Its water mostly comes from aquifers, and to a lesser extent from streams that feed into it. It has a very deep streambed - 5-10 meters deep. The main tributaries of the Bosut are the Studva, some 30 km long, and the slightly shorter Spačva which is some 10 km upstream.

The altitude of the area and its configuration, as well as the Sava's high waters, turn the issue of drainage into a problem which requires a lot of attention. A drainage system only exists in the territory of the City of Sremska Mitrovica, and it comprises 12 basins, six drainage systems covering around 27,000 ha, with a canal length of 1,148 km.

The area of so-called lower Srem is particularly vulnerable. The low elevation of the area and the Sava's high waters, as well as the rising waters of Fruška Gora streams, caused the waterlogging or excess water in so-called lower Srem. Surplus water from the affected areas is drained into the Sava through canalized streams. The canal construction and directing of excess water to the Sava is quite complex due to the unfavorable position of the Sava waters relative to the topographic surface of the water affected Municipality. During low and medium water-levels of the Sava the mentioned waters are drained through canals into the Sava by operation of gravity (the free fall), while during the Sava's high water-levels pumps are used to drain excess water from affected areas. The main canal routes (Galovica, Progarska Jarčina, Obreška krivaja and the Vranj canal) in their current status perform the intended function. The rest of the canal network is for the most part in poor shape due to years of inadequate maintenance.

Galovica is the largest canal in Srem. The general direction of the canal is northwest – southeast, from Buđanovci to Bežanija, covering a distance of about 50 km. Galovica intersects Progarska Jarčina, south to the village of Prhovo. On the right hand-side several canals feed into Galovica: Ugrinovački, Mihaljevački and Draški, etc., while those on the left-hand side include: Legder, Kuvalov and partially canalized Ugrinovačka Marsh. At some places the Galovica canal route also "follows" the Ugrinovačka Marsh.

A multitude of third and fourth category canals feed into each of the mentioned canals. Those smaller canals collect excess water from more than 618 km^2 of the territory.

It is also necessary to continue the expansion and completion of land reclamation systems, while activities should be focused on irrigation, in addition to drainage. For this purpose, the regional hydro system *Srem* is divided into subsystems, but because of the general lack of money in the previous period it has not been completed. This hydro system has been designed for irrigation of 200,000 ha.

Water regulation in Vojvodina has been entrusted to the Public Water Management Company "Vode Vojvodine" (Vojvodina Waters) Novi Sad.

A long-term water supply strategy in Vojvodina is based on the formation of several regional water supply systems, which rely on surface water storage areas and protected groundwater wells. The largest number of settlements will be supplied from them, as will those technological processes which require water of the highest quality.

The regional hydro system *Srem* - Hydro system *Srem* consists of main canals with pumping stations on the Danube, the Sava and the Bosut, which pump water from these rivers into them. Thirty-one Fruška Gora reservoirs - Figure 13 – are also included in the hydro system. The main purpose of the hydro system is to provide water for irrigation of 185,000 ha from main canals and 15,000 ha from reservoirs with water from its own catchment areas, which makes a total of 200,000 ha. In addition to irrigation, the hydro system provides water for the needs of the industry, fish ponds, and on reservoirs also for the sport - recreational and tourism-related purposes.

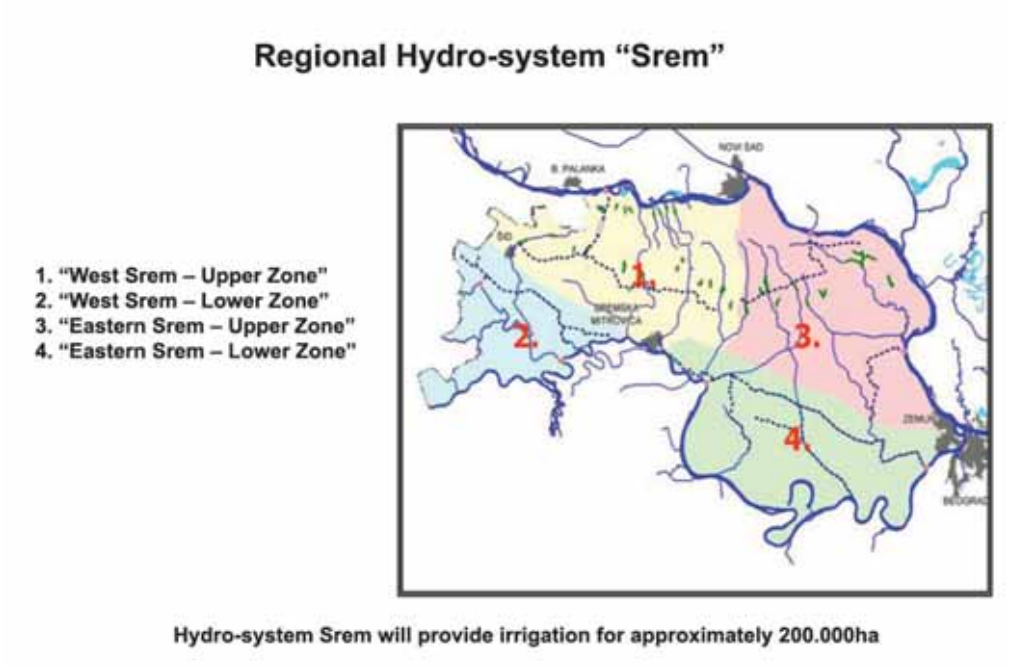


Figure 13 – *Srem* regional hydro system, [23]

The Srem regional system (the source: the Drina and Sava alluvion Jarak-Grabovac, settlements and municipalities that it supplies: Sremska Mitrovica, Ruma, part of Srem from the Belgrade system. It has been envisaged for a later stage to transfer water from the right bank of the Danube),

Fruška Gora is a massive natural obstacle to bringing water from the Danube, and it has been overcome by means of a tunnel. That has given rise to the division of the *Srem* hydro system into following subsystems:

- *Western Srem - Upper Zone*: from the Danube, water is pumped out at Neštin by using a pumping station whose capacity is 16 m^3/s, and then lifted to the elevation of AE 132 m, from where it is brought by an open lined canal to the tunnel with a 3.5 m diameter, 2.5 km length, which then takes it through the massif of Fruška Gora to the southern slope into the Moharač reservoir near Erdevik. From this reservoir water is distributed by two canals, westward to Šid, and eastward to the Kudoš reservoir near Pavlovci,
- *Western Srem - Lower Zone*: the lower zone covering an area of 30,000 ha is fed by water from the Bosut reservoir, but mostly from the Sava river, by using the pumping station on the Bosut near Bosut, whose capacity is 10.6 m^3/s. Water is raised to the elevation of AE 81 m and taken westwards by open canals to Ilinci and eastwards to Martinci, and the canal bed of Vrtić is also used,
- *Eastern Srem - Upper Zone*: this area has been divided into two units, bearing in mind the configuration of the terrain and the position in terms of altitude. The boundary of the higher zone goes along the line Irig-Krušedol-Čortanovci-Slankamen-Belegiš-Stara Pazova-Golubinci-Kraljevci-Ruma-Irig, and the lower zone stretches to the Zagreb-Belgrade highway,
- *Eastern Srem - Lower Zone* – an area is crisscrossed by a network of drainage canals with main collectors Galovica, Jaračka Jarčina, Progarska Jarčina, Tovarnik and Grdenovci. The main collectors are set deeply in the ground and their dimensions are large. The concept for bringing water has been designed in such a way to pump the water from the Sava near Jarak into the Jaračka Jarčina canal, through the main water intake structure and the pumping station *Jarak,* whose capacity is 27 m^3/s.

5.7. Public Sector

Table 16 shows an overview of supply of basic energy products and water. Water supply has been regulated in all municipalities of the Srem District, by entrusting it to the local PUCs and PEs in all municipalities but the Municipality of Irig. Water supply in the Municipality of Irig has been entrusted to JKP Vodovod i kanalizacija (PUC Waterworks and Sewage) from Ruma.

Table 16 – An overview of the existing infrastructure (electricity, natural gas, DHS, potable water)				
Srem District	**Water supply**	**Electricity supply**	**Natural gas supply**	**District heating system**
Inđija	JKP VK	ED Ruma	JKP Ingas	-
Irig	Vodovod Ruma	ED Ruma	JP Gas Ruma	-
Pećinci	JKP VK	ED Ruma	Petrol gas group Rodgas	JKP Sava
Ruma	Vodovod Ruma	ED Ruma	JP Gas Ruma	JP Stambeno
S. Mitrovica	JKP VK	ED S.Mitrovica	JP Srem Gas	JKP Toplifikacija
Stara Pazova	JP VK	ED Ruma	Gas Feromont	JP Direkcija za izgradnju (PE Construction Directorate)
Šid	JKP VK	ED S.Mitrovica	Srbijagas	-

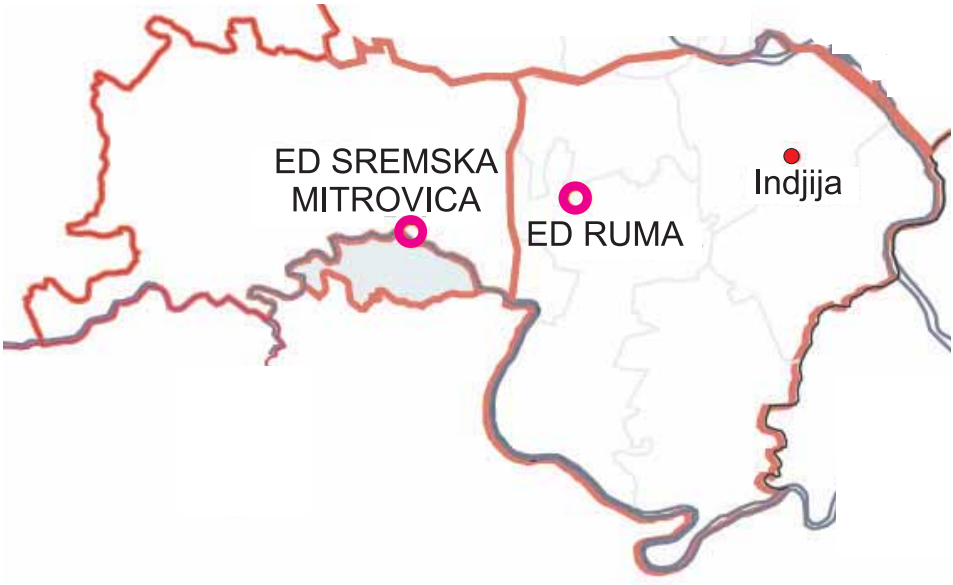


Figure 14 – Srem District: electricity distribution
[Selected electricity data -2013. – PD Elektrovojvodina, Novi Sad]

Since 2006, Elektrovojvodina has been operating as part of Elektroprivreda Srbije (the Serbian Electricity Company) as a business company for electricity distribution, with a registered address in Novi Sad and the consumption area in the whole territory of the Province of Vojvodina, consisting of seven branches. In the territory of the Srem District - Figure 14, electricity is distributed by two branches of PD Elektrovojvodina:

- ED Sremska Mitrovica (distribution of electricity for the municipalities of: S.Mitrovica, Šid),
- ED Ruma (distribution of electricity for the municipalities of: Inđija, Irig, Pećinci, Ruma, Stara Pazova).

The supply of natural gas for the Srem District is secured by JP Srbijagas, indirectly, through its distributors. In four municipalities distributors are local public enterprises (Inđija, Irig, Ruma, S.Mitrovica), while in two municipalities (Pećinci, Stara Pazova), natural gas distributors are privately owned companies.

In three municipalities of the Srem District there is no district heating system (Inđija, Irig, Šid), and local PUCs and PEs are entrusted with the function of supplying, generating, distributing and payment collection in the remaining municipalities.

5.7.1. Institutions-Direct and Indirect Users

Preschool education and care – children of the preschool age (6-7 years) are predominantly included in preschool education and care in AP Vojvodina, while children in the age bracket from three to 6 years of age are included to a much lower extent. In the majority of settlements in the Srem District, preschool education classes are within primary schools, often without a separate zone in the open air (a courtyard). The total number of preschool establishments in the Srem District is eight. Municipality centers mostly have kindergartens, while nursery schools are located mostly in major centers.

Primary education - 51 primary schools work in the territory of the Srem District.

Secondary education - 24 secondary schools work in the territory of the Srem District.

5.8. Existing Infrastructure and Plans for its Further Development

5.8.1. Roads

The position of Srem in transportation terms is extremely favorable and it has a positive impact on the future development of the area. It is located at the crossroads of major European transit routes (Trans-European Corridor no. 10), railway routes (the international railway Budapest-Sofia and Belgrade-Ljubljana), and the Danube (Trans-European Corridor no. 7), on the main transit route connecting Western Europe with Eastern Europe and Asia.

Two internationally important class A roads, or TEM roads (*Trans European Motorways*) go through the territory of AP Vojvodina, namely E-75 Vardo (Norway)- Crete (Greece) and E-70 La Coruna (Spain) - Poti (Georgia), as well as an internationally important B class road E662 Osijek-Sombor-Subotica. These roads belong to the class of category I state roads. The length of category I state road No. 22 (E-75) through Vojvodina is 191 km, of category I state road No. 1 (E-70) through Vojvodina is 168 km (87 km of highway) and a B class international road through AP Vojvodina is E-662 (category I state road no.17.1) Subotica - Sombor - Osijek, whose length is 100 km.

The road transport network of the District comprises roads of different hierarchical levels, which provide a satisfactory level of traffic services based on the level of their development. The level of completion of the existing roads provides access to all the settlements and it can be assumed that there is a satisfactory level of traffic connections.

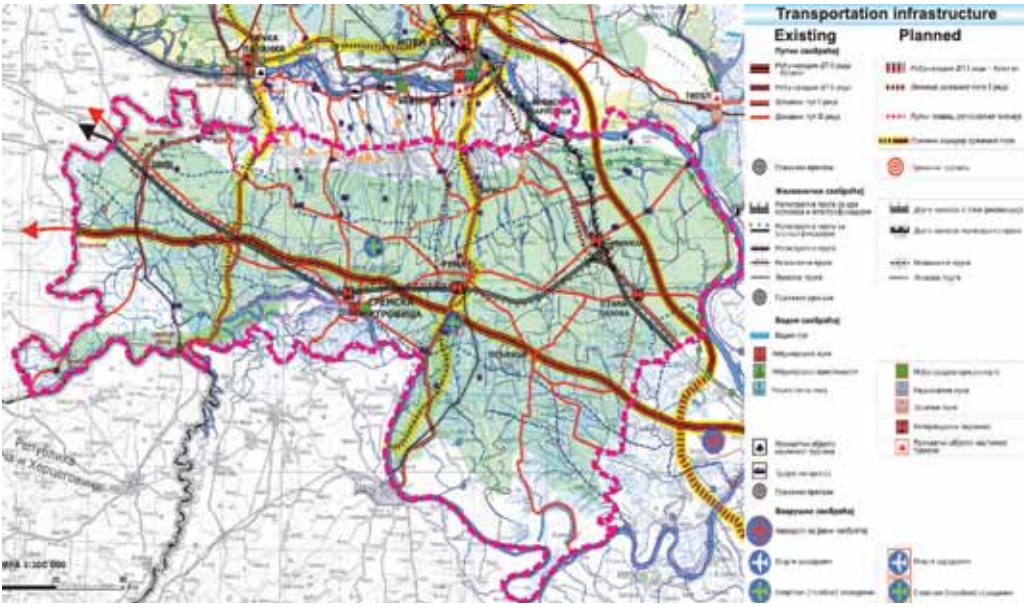


Figure 15 – Network of settlements and infrastructure in the Srem District

Except for the highways (E-70 and E-75), the routes of other public roads are mostly passing through urban parts of the settlements, so that transit traffic creates problems in the functioning of internal traffic, as well as the discharge of urban functions. It is necessary to ensure greater operating speeds along the public roads - state roads of category I and II - and to redirect transit traffic outside the urban areas. The accomplishment of this goal is possible through reconstruction and modernization and construction of a ring-road, as well as the introduction of new traffic capacities of a higher hierarchical level and integrated transportation to optimize transport activities.

Category I state (main) road no.21:
Novi Sad (Petrovaradin)– Irig– Ruma – the border of APV (Klenak)

Category I state road (main road) No.21 stretches diametrically in the space of Srem, from category I state road no.22.1 towards north-western Serbia (Šabac). The route of this state road has different shapes. Thus, at the beginning, it has the form typical of a lowland road (around Novi Sad), and after reaching the zone of Fruška Gora it takes a highland form all the way to Irig, where its shape becomes lowland again up to the final survey mark on the border of APV. The design speed along this

state road is different depending on the road elements and conditions, so in the zone of Fruška Gora it is 60 km/h or less (even 20 km/h), while on the remaining sections, it is 80 km/h, except on sections passing through a settlement and in certain parts where it stands at 60 km/h. The traffic volume and its structure along this road differ, but it is possible to make a general assessment that it features very intense traffic flows (with all types of vehicles in traffic flows), therefore even today there are individual road sections and certain time intervals with heavier traffic flows (which are manifested by long intervals of following the vehicle in front without the possibility of overtaking). But if we take into account the geomorphology of the route and its elements (particularly the section Iriški venac - Irig - the crossroads for Vrdnik), we can generally conclude that speed, ride comfort and safety of the traffic are far below the planned (and permitted) for state roads. The said section Iriški venac - Irig requires either the building of a tunnel or the building of separated lanes per direction (with satisfactory elements) to eliminate this section of the state road that endangers the safety of traffic (in normal conditions, but especially in winter conditions and in difficult traffic conditions - reduced visibility). In the current situation, category I state road No.21 diametrically passes through the urban area of Irig and its manifestations threaten vital internal functions of the settlement as well as the traffic in the settlement. The existing traffic along the main road in Irig significantly undermines the safety of traffic in the settlement, with pedestrians and cyclists being the most vulnerable. In this sense, the beginning of the construction of a ring-road is inevitable in the near future. The further route of category I state road No.21 (from the crossroads to Vrdnik) to Ruma is of a lowland type, with long stretches having excellent visibility and elements that allow the operating speeds at the level of a main road. In the planning documentation there is also a plan for a service road that will integrate all the traffic in the area.

The ring-road around Ruma is an example of properly organized transit flows, as well as the establishment of spatial links with roads in the vicinity, with proper grade-separated junctions with the railway and the highway. Such course of the route of the state road towards Šabac is a lowland route in terms of its shape, passing through settlements (Jarak, Hrtkovci and Platičevo) and along the boundary of the settlement Klenak. Along this route (outside the settlements), road elements are satisfactory for that road class. However, in the settlements, road elements and points of conflict with other forms of transport in the settlements contribute to the lowering of the operating speed, as well as the deterioration in ride comfort and road safety. At the current level of traffic load, there is a need to build ring-roads around these settlements, but these demands will be met if they are included in the spatial planning documents, once all conditions are met (traffic and economic). Category I state road (main road) No.21, in its existing situation in the territory of Vojvodina, has a total length of 64.4 km with a width of 7.1 m.

Category I state (main) road no.18.1: the border to Croatia (SOT) – Adaševci

Category I state road (main road) No.18.1 represents only a segment of state road No. 18, up to the trans-European route of E-70 highway. This category I state road (main road) stretches along the border in the western part of Srem. In the current situation it has a lowland shaped route that passes through the settlements and intersects with other traffic capacities at the same level with a series of conflicting points. The conflicts of this state road with urban functions within the urban agglomerations (especially in Šid) are evident, especially in areas with higher traffic volumes (zones in the centers of settlements, work zones), and in order to minimize that and bring it down to acceptable limits, partial measures were first applied, only to proceed at a later stage with the implementation of solutions involving ring-roads (within the planning documentation). The implementation of these solutions did not ensue due to reduced transportation demand. The intensity and structure of traffic along this main road are monitored by means of automated vehicle counting systems. The volume and structure of traffic determined so far will be used to calculate future traffic intensity, i.e., for forecasts in order to make future capital investments cost-effective. A future solution for a ring-road around Šid will need to be implemented during the end of the second decade of this century, i.e., around 2018, with the rest of the route being preserved in its entirety and adapted to this new solution. Due to the newly created conditions, it is necessary to establish a new spatial link to state road No.18, which will be established after determining the location for a new bridge on the Danube.

Railway traffic is carried out along the main railway routes (Belgrade - Zagreb and Belgrade-Novi Sad-Subotica - Hungary), and in terms of its intensity it is important in the transport of goods for the needs of this region, as well as for the transit originating from the neighboring countries. The railroad Šid - (Sremska Rača) - Bijeljina constitutes a link to Republika Srpska. However, the level of completeness and the status of railway lines, stations, as well as station structures do not ensure the required level of exploitation by European standards, and this railway line must be overhauled (increase in the capacity, repair of other elements to increase operating speeds, as well as building of another track and full electrification). It is necessary to build a modern technological station and all related facilities (industrial siding), as well as proper logistical support for modern business.

There is no air traffic in the territory of the Srem District municipalities, instead, all the demand for this mode of transportation is met through the existing airport in Surčin, which is situated in the immediate vicinity.

5.8.2. Navigable Waterways

The rivers Sava and Danube are fully navigable throughout their respective courses in the District of Srem. The Sava River is an international navigable river that connects Croatia and Republika Srpska with Serbia, and then all of them with the navigable Danube. In

regional terms, the Sava connects the center of the District, Sremska Mitrovica, with other centers: Bijeljina, Šabac, Belgrade. Strategic economic and industrial potentials have been built on its banks with very promising Port of Leget and the Sava Shipyard. However, the situation of river transport is characterized by unattended waterways, unfurnished ports, piers, unbuilt passenger piers and a marina.

As for the other municipalities, water traffic in the current situation is rarely used to transport goods (excluding the cargo berth for bulk cargo in Stari Slankamen) for the needs of this area. There are excellent conditions for greater inclusion of this mode of transport in the redistribution of transportation activities, but large investment projects are required for the development of this mode of transportation in this area (through the construction of a marina, etc.).

5.8.3. Energy Sector

5.8.3.1. Generation, Transmission and Distribution of Electricity

The electric power system of the Srem District comprises a high-voltage transmission system and a distribution network. The transmission system is managed by JP Elektromreža Srbije (Serbian Power Transmission Company) through the Novi Sad regional dispatch center. Corridors of the transmission network with voltage levels of 400 kV, 220 kV and 110 kV are shown in Figures 16 and 17.

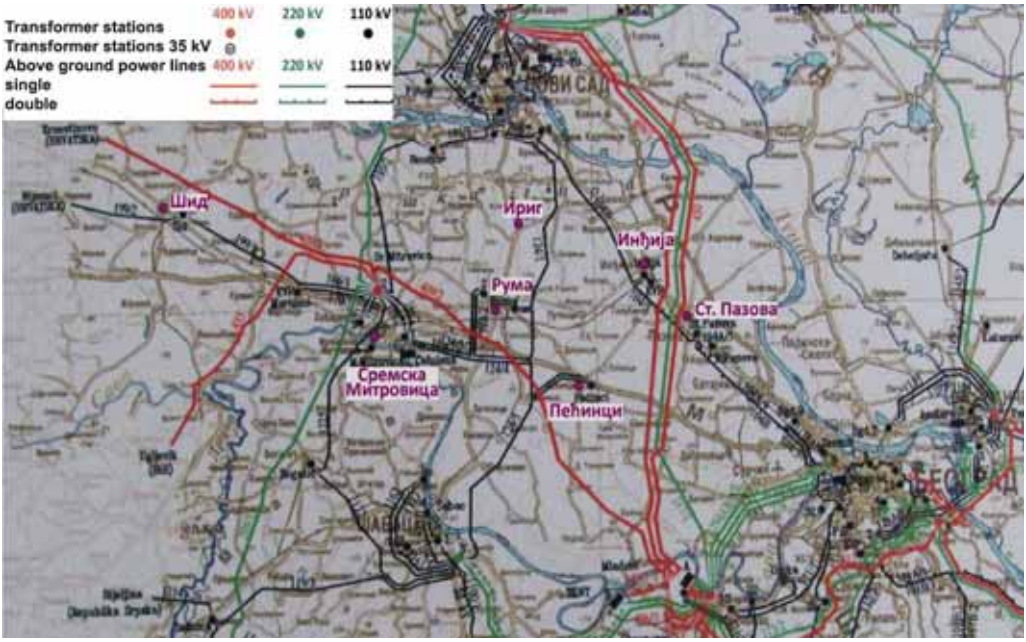


Figure 16 – Layout of the electrical power transmission system in the Srem District

The existing electricity infrastructure represents the potential of a given area, but at the same time, the overhead high voltage lines (400 kV, 220 kV and 110 kV) constitute a limiting factor for the construction of buildings in the area in the immediate vicinity of the network, i.e., in safety corridors.

Distribution of electricity in the territory of the Srem District is performed by Elektrodistribucija *Ruma* and Elektrodistribucija *Sremska Mitrovica* that operates within the Business Company for distribution of electricity Elektrovojvodina d.o.o. The length of the electricity distribution grid with different voltage levels, the consumer structure and the electricity consumption in these two companies are shown in Table 1.8.

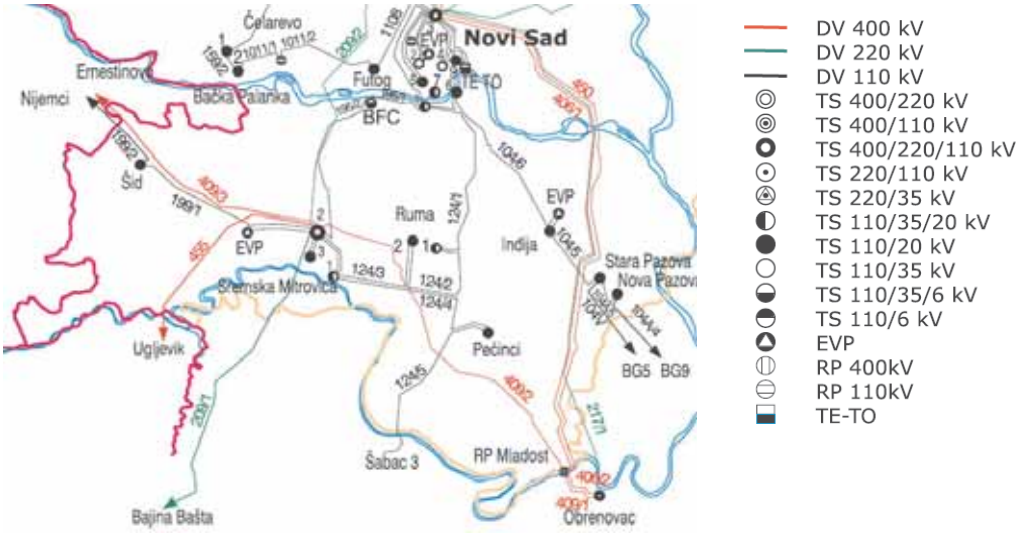


Figure 17 – Electricity system in the Srem District (January 2012)

Table 16 – Electric Power Distribution Grid in the Srem District					
Grid length [km]					
	35 kV	**20 kV**	**10 kV**	**0.4 kV**	**Total**
ED Ruma	100.98	951.08	55.67	1,444.72	2,552.45
ED Srem. Mitrovica	59.68	510.02	24.38	526.52	1,120.60
Consumer structure					
	High voltage		**Households**		**Other consumption**
ED Ruma	144 (0.16%)		81,529 (88.15%)		10,812 (11.69%)
ED Srem. Mitrovica	72 (0.16%)		39,317 (88.83%)		4,871 (11.01%)
Actual consumption (GWh)					
	2007	**2008**	**2009**	**2010**	**2011**
ED Ruma	803	825	823	851	860
ED Srem. Mitrovica	378	386	391	402	397

The general observation for the whole district is that the level of development of the transmission and distribution network is satisfactory in terms of coverage of the area, but not in terms of capacity and technical characteristics of the lines and distribution substations. The secondary (low voltage) network supplies electricity to consumers directly and it can be noted that it covers all the inhabited places. The existing low voltage network is mostly an aerial network.

The development of the transmission network must follow the growing demand for electricity. The largest part of investment by 2015 (the current medium-term plan) will be earmarked for the rehabilitation and upgrade of the transmission system, the construction of new 400 kV, 220 kV and 110 kV transmission lines, the construction of new 400 kV interconnection links to neighboring cross-border systems, the construction of 110 kV connections for users of the transmission system, the construction of 400 kV and 220 kV substations and replacement of large substations with power of 400 kV and 220 kV with new units. In order to ensure more secure and reliable supply for consumers in the planning period, further development will be continued by building new and reconstructing existing transmission systems of all power levels and distribution infrastructure facilities and lines (starting from 110 kV to end-users). The overall industrial and demographic development of AP Vojvodina will dictate the need for possible changes and corrections in the routes of the existing 110, 220 and 400 kV distribution lines, as well as some remodeling and rehabilitation to increase the safety and security in the operation of the existing network of distribution lines.

The distribution network will develop in accordance with the Energy Sector Development Strategy by 2015, the Program for Strategy Implementation and medium-term plans of the relevant company JP EPS and/or of the Business Company for electricity distribution *Elektrovojvodina*. Full transition to the 20 kV voltage level, i.e., transition from three-step 110/35/10 (20) kV transformation to a two-step 110/20kV transformation is envisaged, including the reconstruction of all 110/35 kV substations into 110/20 kV ones. The 35/20 kV or 35/10 kV substations will be reconstructed into 20 kV distribution hubs, while the 10 kV distribution network and attached 10/0.4 kV distributing substations need to be reconstructed for operation at 20 kV. An increase in electricity consumption at an average annual growth rate of 1.8% has been anticipated for the entire planning period, which requires an upgrade of the capacity of existing substations, where possible, as well as new capacities. The planned 110/20 kV substations in the territory of the ED *Ruma* are:

- Substation Inđija 2
- Substation Krnješevci

Other 20/110 kV substations for connection of power generating facilities using renewable energy sources, for the needs of large consumers, and 110/20 kV substations will be constructed in accordance with development plans of the electricity distribution companies.

5.8.3.2. Transmission and Distribution of Gas

Consumers are supplied with natural gas through a transport system of high pressure main and distributing gas pipelines, at the level of 50 bars. The layout of the gas pipeline system in the Srem District is shown on Figure 18.



Figure 18 - Layout of the system for natural gas transport in the Srem District

From the main gas pipeline MG 04/II (MJP Gospođinci - MJP Batajnica), at the site located 2.5 km south of Novi Karlovci, near the road Novi Karlovci - Stara Pazova, a distributing gas pipeline for Sremska Mitrovica branches off. In addition to this, Sremska Mitrovica is connected to another distributing pipeline built for the needs of the Matroz Industry, which is connected to the distributing pipeline Batajnica - Loznica - Zvornik, near Nikinci (MMRS Nikinci is connected to this distributing pipeline). The distributing gas pipeline which goes to Sremska Mitrovica passes through the territories of the municipalities of Ruma, Inđija, Stara Pazova and Pećinci, and the settlements in the municipalities are connected to them through MMRSs and MRSs. MMRS Beška is directly connected to the high pressure gas pipeline from MG 04/II.

It is possible to conclude that the municipalities of Inđija, Stara Pazova and Ruma have fully built gas pipeline infrastructure, and that further works on gasification in these municipalities will be performed with a view to extending the existing gas pipeline network of low and medium pressure in parts of the settlements which have seen the expansion of housing, as well as in new industrial zones. In Sremska Mitrovica and Pećinci the gas pipeline infrastructure is partially constructed and further work is primarily related to the expansion of the distribution network. At this point, works are underway to connect the municipality of Šid to the existing pipeline system, that is, via high-pressure gas pipeline RG-04-17 Inđija - Sremska Mitrovica. The construction of the gas pipeline Sremska Mitrovica - Šid (RG-04-17/I), Tilva-Bela Crkva, Bačka

Palanka-Bač, Ruma-Pećinci (RG-04-10), Sombor-Kljajićevo, Subotica- Žednik, the distributing gas pipeline from MMRS FLOAT to MMRS Kovačica, the distributing gas pipeline from MG-04-15 to MMRS Odžaci, Šajkaš-Titel and Kovačica-Opovo, will create preconditions for gasification of all inhabited places in the municipalities of Šid, Bela Crkva, Bač, Pećinci, Sombor, Subotica, Kovačica, Opovo, Odžaci and Titel. Upon completion of these sections of the gas pipeline all municipalities in Vojvodina should be gasified and networked into a single gas pipeline system. The construction of the planned gas pipelines will lead to improved performance and reliability of the existing main and distributing gas pipeline network, energy stability in the supply of natural gas and creation of prerequisites for further economic development.

5.8.3.3. Heat Generation and Distribution

Systems for generation and distribution of heat exist in Sremska Mitrovica, Ruma, Stara Pazova and Pećinci. These are mostly boiler rooms for apartment blocks with power below 10 MW. These systems are managed by local utility companies. Since heat generation and distribution have no fundamental features related to the district as a whole, they are separately considered in sections dealing with individual municipalities.

5.8.3.4. RES

Other renewable energy sources (in addition to biomass) in Vojvodina include: solar energy, wind energy, hydro potential of running and stagnant water and the potential of geothermal water or steam. On the basis of the existing studies, we can say that there are natural advantages in Vojvodina to use renewable energy sources. Renewable (unconventional) energy sources are currently poorly represented, accounting for 7.7% of total primary energy production in Vojvodina, or about 2.0% of total consumption. The energy has been generated from solid and liquid biomass, and to an insignificant extent from geothermal energy, while generation from other unconventional sources has not yet developed.

A study entitled *Atlas of Winds in the Territory of AP Vojvodina* has been prepared for the use of wind energy, and also numerous energy permits for wind farms have been issued. Problems in the segment of renewable energy are as follows: inadequate infrastructure for using renewable energy sources, the lack of reliable data on the potential of renewable energy sources and the lack of an effective system of financial instruments for more massive use of renewable energy sources.

In Vojvodina, there is a long tradition of wind energy utilization, but at this point there is not a single wind farm which would transform this energy into electricity. Studies indicate significant wind energy potential that can be used for this purpose. In the territory of Inđija Municipality, there is a plan to build a 20 MW wind farm on the

Beška - Krčedin section and an area of about 100 ha. The findings of the studies show that most of the territory of the Srem District is in the zone where the wind speed is 3.5 – 4 m/s - Figure 19).



[V. Katić, Atlas vetrova AP Vojvodine (AP Vojvodina Wind Atlas), FTN, Novi Sad, 2008.]

a) Wind power density at 100 m

b) Wind speed and energy potential at *50* m above the ground *in* W/m²

Figure 19 – Republic of Serbia/AP Vojvodina – wind speed and energy potential

Regarding the potential of solar energy, the exact data for the Srem District is not available, but based on maps of insolation and other data available for the entire territory of Serbia, it can be assumed that these are the values of the constants of radiation between 3.3 and 4.4 kWh/m² a day, i.e., the radiated energy of 1,400 kWh/m² a year. On the same basis it can be assumed that the annual insolation duration ranges between 2,200 and 2,400 hours.

The municipalities of the Srem District have hydro-geothermal potential. The level of utilization of **geothermal energy** for the time being is very low in spite of significant heat potential in this area. In AP Vojvodina, there are 75 hydrothermal wells, with an average yield of 9.5 l/s, and an average output temperature of 48.8°C. The total heat potential (power) of all wells, which have systems built and the possibility of exploitation, is about 54 MW, and about 19 MW or 26% of the available potential is used, mainly for heating purposes in balneology and tourism. There is a precisely defined resource in the geothermal power of wells of about 85 MWt or about 750 GWh/a. Data on the characteristics of the available wells is given in the chapters relating to each municipality individually (Sremska Mitrovica, Inđija, Pećinci).

The potential of agricultural biomass from crop farming and fruit growing in the territories of the municipalities in the Srem District has been estimated by taking into account yields of various agricultural crops.

Table 17 shows the calculated energy potential of agricultural biomass for each of the municipalities in the Srem District, on the assumption that 25% of the available quantities of plant residues are used for energy purposes. The total theoretical potential of the district related to crop farming and fruit growing is 78,694 [toe].

Table 17 - Energy potential of solid agricultural biomass								
Item no.	**Source of biomass**	**Sremska Mitrovica**	**Ruma**	**Inđija**	**Stara Pazova**	**Šid**	**Irig**	**Pećinci**
								[ten]
1.	Wheat straw	2,947	2,117	2,149	1,462	1,919	667	1.557
2.	Soybean straw	1,504	829	1,051	436	2,369	309	154
3.	Corn stover	5,929	4,133	3,131	3,890	5,070	1,338	1.995
4.	Corn cobs							
5.	Sugar beet	9,149	1,728	4,158	5,949	5,058	-	595
6.	Sunflower husks	237	408	793	474	265	316	954
7.	Sunflower stems							
8.	Oilseed rape straw	0	206	753	50	-	-	121
9.	Barley straw	290	153	560	464	121	98	226
10.	Orchard branches	59	44	109	12,9	87	108	18,5
11.	Vineyard grapevine	4	1,7	97	6	43	19	0,5
Total:		**20.119**	**9,620**	**12,800**	**12,746**	**14,932**	**2,856**	**5,621**
Share:		**25.6%**	**12.2%**	**16.3%**	**16.2%**	**19.0%**	**3.6%**	**7.1%**
Total for the Srem District:								**78,694**

Similarly, the potential of biomass from livestock consumption, in the form of liquid manure, is estimated on the basis of livestock. Livestock is analyzed in detail in chapters concerning individual municipalities, and the results presented here - table 18 refers to the total amount of available liquid manure for each municipality, and the related energy potential. The total amount of manure available for the Srem District is approximately 1,287 thousand tonnes. In terms of energy, this amount of biogas would theoretically be sufficient for the production of 129 million m^3 of biogas per year, that is, its energy potential is 66,209 [toe][1].

Table 18 – Amount of liquid manure [t/a] and its energy potential							
Domestic animal category	**Inđija**	**Irig**	**Sremska Mitrovica**	**Šid**	**Stara Pazova**	**Pećinci**	**Ruma**
	[ten]						
sows	16,821	11,796	87,048	43,795	33,902	32,768	55,185
feeders*	18,463	11,908	71,255	42,038	54,168	32,424	66,777
piglets	6,767	5,089	85,414	20,590	21,429	11,918	24,530
beef cattle	73,650	44,890	173,727	72,089	72976	85,246	82,519
poultry	11,533	2,493	20,323	31,179	16,274	8,657	20,509
sheep	5,952	3,747	25,982	15,984	7,635	6,755	8,875
Total	133,185	79,923	463,749	225,674	206,384	177,767	258,395
Biogas [in millions of m^3]	11.1	6.7	38.6	18.8	17.1	14.8	21.5
Energy potential	5,705	3,425	19,875	9,672	8,840	7,618	11,074
Share	8.6%	5.2%	30.0%	14.6%	13.4%	11.5%	16.7%
Total for the Srem District							66,209 [toe]

[1] 10 to 12 kg of liquid manure with 4 - 10% of dry matter is needed to obtain 1 m^3 of biogas (Furman et al., 2007)

An assessment of the potential of forest biomass can be made on the basis of the weight of felled timber and the share of technical wood in it. Based on the available data for 2012 it is possible to arrive at a theoretical energy potential of woody biomass at the level of the Srem District of 16,108 [toe] a year[2], with distribution by municipality as shown in Table 19.

Table 19 – Energy potential of available woody biomass

Inđija	Irig	Sremska Mitrovica	Šid	Stara Pazova	Pećinci	Ruma	Total
							[ten/a]
67	570	1,890	6,681	-	3,500	3,400	16,108
0.4%	3.5%	11.7%	41.5%	-	21.7%	21.1%	100%

5.9. Protected Areas

The most important protected areas which are located in the territory of the Srem District are the Fruška Gora National Park, and Special Nature Reserves Zasavica, Obedska Pond and partly the Kovilj-Petrovaradin Marsh.

The Fruška Gora National Park was placed under protection in 1960 and is a natural resource of the first category of the highest importance to the Republic of Serbia. The Special Purpose Area Spatial Plan by 2022 provides for a three-stage protection regime. The mentioned Spatial Plan defines a protective zone around the National Park, in which the purpose of the space has been prescribed as well as the rules for its protection, development and use. In the protective zone, there are certain areas designated for the protection of natural values (potential natural resources).

Areas earmarked for protection, as taken over from the Spatial Plan of the Fruška Gora National Park, include grassland steppe areas, preserved in narrow belts of valleys and deep valleys of streams, and artificial lakes at the foot of the southern slopes of Fruška Gora. The group of endangered species includes species of birds of prey, of which the most important is the eastern imperial eagle for which these areas are the basis for survival, because they represent its nutritional base, mammalian species (ground squirrel) on which it feeds, and plant species (pheasant's eye, orchids), as well as other representatives of the rare flora and fauna of Fruška Gora. Protection and conservation of habitats of species - natural rarities is of importance for the conservation of Fruška Gora's biodiversity wealth.

[2] Assumed density 0.75 t/m^3, lower calorific value 7,000 kJ/kg

At the international level, due to its exceptional ornithological values, Fruška Gora has been declared an important habitat of birds, plants and butterflies (IBA, IPA and PBA area). Since 2000, in addition to the territory of the National Park, it covers a wider zone of influence, whose total area is approximately 42,000 hectares.

Special Nature Reserve Zasavica is a nature reserve placed under state protection in 1977 as a first category natural resource of exceptional importance. On the national network of Ramsar protected areas (wetlands and other ecosystems under the Convention on Wetlands of International Importance which our country has ratified), Zasavica found its place on the list of Ramsar sites in Serbia (proclaimed in 2009 as the ninth Ramsar site in Serbia), and according to the classification of the International Union for Conservation of Nature (IUCN), as an area of habitats and species management it has category IV.

Special Nature Reserve Obedska Pond constitutes the remnants of a swamp with its specific biological and biogeographic characteristics, and is a unique phenomenon in Europe. It has the shape of a horseshoe, which is the former riverbed of the Sava. It is characterized by extremely rich biodiversity with a significant presence of rare and endangered species of national and global importance. It is a habitat of numerous sensitive ecosystems, especially wetland habitats and ancient forests of Pedunculate oak trees and salt marshes. A special emphasis is put on the significance of bush, tree, wetland and meadow associations for the survival of a unique, rich and diverse bird colony on Obedska Pond. The total proven wealth of bird fauna is 220 species of birds, 50 species of mammals, 16 species of fish, over 1200 species of insects, over 200 species of zooplankton, around 180 species of fungi, 500 species of plants and 50 species of moss.

In order to preserve this natural asset, the Obedska Pond complex was placed under protection as a strict nature reserve. On the basis of the Ramsar Convention (1977), this area has been put on the list of internationally important wetlands. Obedska Pond is also on the list of important bird areas in Europe.

The special nature reserve Kovilj-Petrovaradin Marsh was protected in 1998 and is a category I natural resource, of the highest importance to the Republic of Serbia. The area of the Special Nature Reserve is 4840.60 ha. The boundary of the protective zone tallies with the boundary of the protected natural resource, except in the case of the southern border of the Kovilj Marsh and/or the north-eastern border of the Petrovaradin Marsh, where the protective zone comprises the Danube from 1250th km to 1231th km. It is located on the territories of the municipalities of Novi Sad, Sremski Karlovci, Inđija and Titel.

5.10. Energy Consumption

Energy consumption has been reviewed at the level of each municipality. Bearing in mind that an energy management system has not been established in any of the municipalities in the District, available data is very different and does not enable a synthetic review at the level of the entire Srem District.

5.10.1. Biomass Sources and Their Development Projection

Figure 20 shows the biggest producers of pellets and briquettes in the Srem District. Likewise, the Figure shows locations of Miscanthus trial fields (educational center Futura – Sadžak, Zasavica – Sremska Mitrovica) as well as the location of the cooperative *Bioenergo* in Noćaj (a 10 ha plantation of Miscanthus on degraded land – the plan: to expand the plantation to 100 ha).

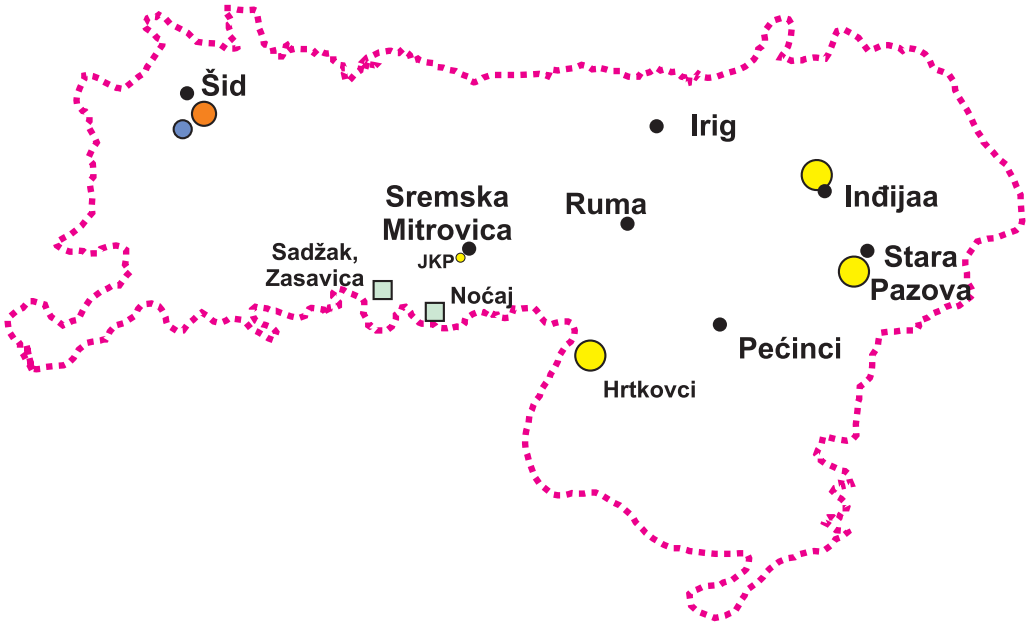


Figure 20 – The biggest producers of pellets and briquettes in the Srem District

Figure 20 shows the following localities:

- Miva, Inđija - (palette production from straw 12500 t/a),
- Agro Pellet tim doo, Stara Pazova – production of agro pellets and boilers on pellets,
- Angler doo (YU Pellet) - Hrtkovci - pellet factory,
- Bio Energy Green, Šid - briquette factory,
- Victoria Oil, Šid - plant for pellet production from straw for own needs,
- PUC Regional Landfill Srem-Mačva - pellet production line 100 kg/h.

5.10.2. Potential Technologies for Energy Generation from Biomass

Boilers fueled by biomass in DHS [Technology Data for Energy Plants. -- Generation of Electricity and District Heating, Energy Storage and Energy Carrier Generation and Conversion. -- May 2012 - certain updates made in October 2013 and January 2014.]

Boilers can use wood chips from forests or wood processing industry, pellets (wood, straw) or only straw as fuel.

If the moisture content of the fuel exceeds the range of 30-35%, as is the case with forest wood chips, it would be necessary to apply the solution involving condensation of flue gases. The efficiency level depends primarily on the temperature of condensation, whose value is slightly higher than the temperature of hot water in the return pipe of DHS. In well thought-through systems, hot water temperature in the return pipe is below the value of 40°C, which contributes to an increase in the level of efficiency of the mentioned boilers. Some plants are equipped with cooling systems in order to achieve complete condensation of flue gases, which can further increase the level of efficiency of the plant.

Boilers using straw as fuel must be equipped with baghouse filters (instead of electro-filters - a common solution when wood chips are used as fuel), to ensure reduced emissions of harmful substances.

Typical boilers fueled by wood chips can be relatively easily regulated during their operation, in the range of 25 - 100% of full capacity, without violating the set greenhouse emissions standards.

The standard power of **boilers using wood chips** ranges from 1 to 12 MW.

- The nominal investment costs for this type of plants are 500-1100 €/kW,
- Operation and maintenance costs: 0.0054 €/kWh.

The standard power of **boilers using straw** ranges from 1 to 12 MW.

- The nominal investment costs for this type of plants are 500-1100 €/kW.
- Operation and maintenance costs: 0.004 €/kWh.

Internal combustion engines

Internal combustion engines (ICE engines) are widely used in electricity generation for covering both base and peak loads. They are produced in the power range from several kilowatts up to 10 MW. If you need more power, it sometimes pays off to apply several engines. In combined generation, they can produce hot water or low pressure steam.

There are two basic types of engines used for commercial purposes: Otto and Diesel engines. They differ in the method of ignition of the mixture of fuel and air. In the case of ICE engines 30% of the heat produced by the fuel is discharged through cooling fluid to the crankcase, while 30% is discharged through exhaust gases. Exhaust gas temperature can vary from 650 ° C at full load up to 500 ° C at 60% of load for four-stroke gas engine (Otto engine that burns gas).

Gas engines can be started relatively quickly (reaching operating mode in 5-15 minutes). Otto engines can use as fuel natural gas, biogas and special gases from the gasification process. There are variants on the market with options to use different types of fuel.

High power gas engines usually have a level of efficiency above 40%. In cases where gas engines operate on biogas it is possible to expect a slightly lower efficiency level of the gas engine as such by 1%.

ICE engines are suitable for combined generation. The combined generation can produce hot water or low pressure steam for the process purposes or for central heating needs.

In the combined mode of operation, the overall level of efficiency is in the range 86 ÷ 94%. The price for the installed set varies and ranges between 1000 and 1500 €/kW. However, in cases where biogas with very high sulfur content is used, a decline in the overall efficiency level (combined heat and power generation) can be in the range of 10-15%, so that the aforementioned value ranges from 73% to 79%. Additional nominal costs in case biogas is used as fuel range between 1050 and 1600 €/kW. Total operation and maintenance costs are 0.0074-0.011 €/kWh. Possible additional costs for operation and maintenance can reach the level of 0.008 €/kWh for each kilowatt hour of electricity produced if biogas is used.

Stirling engine

Stirling engine works on the principle of a temperature difference that is generated in the outer units for heating or cooling. One part of the engine is constantly at a high temperature, while the other is constantly at a significantly lower temperature. In this type of engine hydrogen or helium under pressure are most commonly used as working fluids. In the described conditions, the working fluid flows between the 'heated' and 'cold' sides of the engine driving the piston system of the engine.

The fuel which can be used includes wood chips, residues of the wood processing industry, energy crops, and the like. Requirements relating to moisture content and fuel size depend on the structural solution for the gasifier. A Stirling engine can also use natural gas or mineral oil as fuel.

A Stirling engine produces electricity and heat. The level of efficiency when using wood chips as fuel is around 18%. Electrical power that can be produced by a Stirling engine is 35 kWe. When it is necessary to produce higher power, it is necessary to install more such units, which may have a common gasifier.

The main advantage of a Stirling engine is reflected in the fact that it can use as fuel residues from forestry and agriculture, which typically have a very low economic value. Moreover, the emission level is very low. Finally, the requirements in terms of maintenance of a Stirling engine are significantly lower compared to the Otto and diesel engines. On the other hand, the main disadvantage is its relatively high price compared to Otto and diesel engines. Therefore, the ideal use of these engines is the base operating mode, in cases where a large number of working hours is needed, 6000-8000 h/year

Characteristic values for the plant (**Stirling engine, up to 37 kWe, fuel: biomass**):

- Efficiency level for generation of electricity: = declined by a further 20%
- The nominal investment costs for this type of plants are € 5,000/kW.
- Fixed annual operation and maintenance costs: 32 €/kW/year
- variable operation and maintenance costs: € 0.0026/kWh

Characteristic values for the plant (**Stirling engine, up to 37 kW$_e$, fuel: biomass**):

- Efficiency for generation of electricity: η_e = 20%
- The nominal investment costs for this type of plants are 5000 €/kW.
- Fixed annual operation and maintenance costs: 32 €/kW/years
- Variable operation and maintenance costs: 0,0026 €/kWh

Gas turbines

Gas turbines are widely used in the production of electricity and in combined generation. The basic elements of the gas turbine are turbo compressor, a combustion chamber and a turbine. There are two basic types of gas turbines:

- gas turbines derived from aircraft engines (Aeroderivative gas turbines),
- industrial turbines designed only for stationary applications in the energy sector and industry.

Typically the fuel is natural gas and diesel fuel. Some gas turbines can use other types of fuels such as biogas, LPG. On the other hand, certain gas turbines can be structurally adapted to use different types of fuel (gas/diesel). For gas turbines which use gas as fuel, working gas pressure must be provided within the range of 20-67 bars, depending on the existing degree of compaction of the gas turbine.

As a result of the gas turbine operation electric power and optional heat are generated (combustion product recovery at the exit of the turbine). The range of installed capacity is from 20 kWe to 330 MWe.

Gas turbines can be relatively quickly stopped and restarted in a few minutes, and in such a manner the peak load can be effectively covered. However, each stop and restart

has a direct impact on maintenance costs and the schedule of regular servicing. Gas turbines can also operate at partial load, which results in a reduction efficiency level (η_e).

Efficiency of small and medium power gas turbines is usually between 25-35%, and for larger turbines it can reach a level ranging from 34% to 44%. The price for an installed set varies from 400 to 900 €/kW.

The application of gas turbines operating in a combined cycle is most common in plants with installed capacity of over 15 MW.

In the combined operating mode (in combination with a condensing turbine) in plants with higher installed capacity, the level of efficiency ranges from 55% to 58%. Nominal investment costs for this type of plants are in the range of 870-950 €/kW.

In the combined operating mode (in combination with a backpressure turbine) in plants with medium and low installed capacity, the level of efficiency ranges from 40% to 55%. Nominal investment costs for this type of plants are in the range of 1100-1600 €/kW.

Plants for combined heat and power generation

The basic components of the plant are: systems for the preparation and transport of fuel (biomass), a steam boiler, a steam turbine, a generator and a waste-heat boiler (hot water or steam).

Generally speaking, it is possible to use biomass in these plants whose moisture content is up to 60% (wood chips), while the maximum allowed moisture content for straw is 30%. For the use of pellets in these plants the requirement for moisture content is below 10%.

Wood is definitely the preferred bio-fuel due to the smallest content of unfavorable substances. Agricultural biomass, such as straw and Miscanthus, has a significantly higher proportion of nitrogen, sulfur, potassium and chlorine, leading to much higher levels of primary emissions of NOx and increasing the amount of ash, which contributes to the occurrence of corrosion and deposits on the surfaces of the boiler.

The usual installed capacity of these plants ranges between 1 and 10 MW_e for small installations, i.e., 10-50 MW_e for plants with medium power.

Typical parameters for plants (**medium-power steam turbine** 10-50 MW_e**, fuel: wood chips**):

- efficiency for the production of electricity: $\eta_e = 29\%$
- the overall level of efficiency (without flue gas condensation): $\eta = 64\%$
- the overall level of efficiency (with flue gas condensation): $\eta = 77\%$
- the nominal investment costs for this type of plants are 4000 €/kW.
- fixed annual operation and maintenance costs: 29 €/kW/years
- Variable operation and maintenance costs: 0,0039 €/kWh

Typical parameters for plants (**medium-power steam turbine** 10-50 MW_e**, fuel: straw**):

- efficiency for the production of electricity (at full power): $\eta_e = 29\%$
- the overall level of efficiency (without flue gas condensation): $\eta = 64\%$

- the overall level of efficiency (with flue gas condensation): $\eta = 72\%$
- The nominal investment costs for this type of plants are 4000 €/kW.
- Fixed annual operation and maintenance costs: 40 €/kW/years
- Variable operation and maintenance costs: 0,0064 €/kWh

Typical parameters for plants (**backpressure low-power steam turbine** 0.6-4.3 MW_e, **fuel: wood chips**):

- efficiency for the production of electricity (at full power): $\eta_e = 25\%$
- nominal investment costs for this type of plants range from 5000 to 7000 €/kW.
- total fixed annual operation and maintenance costs: 150 €/kW/years

Typical parameters for plants (**backpressure low-power steam turbine** 8-10 MW_e, **fuel: straw**):

- efficiency for the production of electricity (at full power): $\eta_e = 29\text{-}30\%$
- the overall level of efficiency: $\eta = 90\%$
- nominal investment costs for this type of plants range from 5000 to 7000 €/kW.
- total fixed annual operation and maintenance costs: 4% of investment.

5.10.3. Transport and Logistics

Tables 20 and 21 present basic amounts related to transport and services associated with biomass handling. Table 20 shows approximate unit prices of transport, loading and unloading of baled straw, in EUR/t of baled straw. Prices are also given for cases when transportation, loading and unloading of baled straw are carried out by hiring third parties on the market, and in cases where transportation, loading and unloading are carried out by the owner of the motor pool. The prices have been structured based on 20 t and 25 t trucks, as well as the length of transport.

Table 20 – Transport costs for baled straw and prices of related services

Dimensions of straw bales: Diameter: 1.2 m (350 kg), 2.5 x 1.2 x 0.7 (400 kg), 2.5 x 1.2 x 1 (500 kg)

		Price [€/t]			
		20 t		25 t	
	Type of service	Own motor pool	Rental	Own motor pool	Rental
1	Transportation of straw up to 30 km	3.5	3.6	2.9	3.0
2	Transportation of straw up to 50 km	4.1	4.3	3.4	3.5
		Own motor pool		Rental	
3	Loading of straw	0.65		0.9	
4.	Unloading of straw	0.65		0.9	

Table 21 shows transportation costs for woody biomass and other indirect transport-related services. The service prices of a public enterprise dealing with, *inter alia*, the sale of timber and firewood, published in public domain, were used as a source. On the basis

of presented values, it can be clearly observed that in certain cases the price of transport may depend on the transport route itself. The prices are in EUR/m^3, that is, in EUR/prm, (prm –meter of cordwood: a measurement unit for wood stacked in stacks with air space (mostly for cordwood and split wood)).

Table 21 – Prices of transportation for woody biomass and other services

Item no.	Type of service	Unit	Price [€]			
			10 km	16 km	25 km	26 km
1.	Transportation of saw logs and thin roundwood of conifers	[m^3]	3.32	3.32	4.14	4.96
2.	Transportation of saw logs of broadleaved trees	[m^3]	4.14	4.14	4.96	5.78
3.	Loading of roundwood	[m^3]	1.33			
4.	Unloading of roundwood		1.15			
6.	Transportation of cordwood	[prm]	4.56			
7.	Loading of cordwood		1.33			
8.	Unloading of cordwood		1.02			
9.	Work of an LKT – 81 tractor Work of an IMT tractor Work of a TG – 80 bulldozer	[h]	39.9			
	idling	[h]	13.3			

6. Gender Aspects and Equal Opportunities: Conclusions and Recommendations

6.1. Introduction – Context of Serbia in the Field of Gender Equality

The work on development of legal and institutional frameworks in the field of gender equality and activities to improve the position of women has been stepped up in Serbia since 2002.

The Gender Equality Law was adopted in 2009. The Law prescribes the obligations of local self-government bodies in ensuring equal participation of women in all decision-making processes at the local level, gender-based assessment of the policies and the establishment of institutional mechanisms for this purpose, ensuring equal access to positions and jobs and so on.

The Serbian Government adopted in 2010 the National Strategy and the National Action plan to implement the Strategy for improving gender equality and enhancing status of women. The strategy includes six priority areas: economic activity, political decision-making, education, health, violence against women and the media or combating stereotypes in the media.

Local self-governments have been designated as lead agencies for the activities under the National Action Plan. Actions of local self-governments aimed at encouraging equal opportunities and achieving gender equality are defined by the Law on Local Self-Government, in general terms, through competences of the municipality and anti-discrimination legislation and/or policies in this field.

For the purpose of implementation by municipalities of policies and programs in the field of gender equality, as stated above, the Law has provided for the establishment of local mechanisms for gender equality (working bodies, appointed persons, persons working as gender equality officers). In fact, the initiation and establishment of local mechanisms started in 2002, well before the enactment of the Law, but it turned out that:

- mechanisms have not become operational in all municipalities,
- their establishment has not secured a gender mainstreaming in policies and programs at the local level.

Gender equality mechanisms have been established at all levels in the legislative and executive branches, at the national and provincial levels.

In addition to the institutional mechanisms in Serbia, independent regulatory bodies have been established pursuant to other laws, which ensure the respect for the rights and freedoms of citizens: the Ombudsman, the Commissioner for Equality, the Commissioner for Information of Public Importance and Personal Data Protection.

Along with the institutional framework for the promotion of gender equality or gender mainstreaming in the broader sense, the individual pieces of legislation have established affirmative action measures for women in various fields, of which the most concrete one is the quota for the less represented gender on the electoral lists defined by the Law on the Election of Deputies and the Law on Local Elections. This measure resulted in a third of MPs being women (34%) and for the first time in the history of the National Assembly, it has 84 female MPs, who in their previous term (2012-2014) founded the Women's Parliamentary Network.

In the Government of Serbia out of 19 cabinet ministers, four are women, while only 9 women are presidents and/or mayors out of 169 municipality presidents and mayors.

The areas in which the biggest differences have been identified on the basis of statistics in the status of men and women, or areas where the position of women is most unfavorable, include:

- economic activity and employment: women are inactive, less employed than men, especially less employed in the private sector, they are rarely the heads of agricultural holdings and owners of private businesses (entrepreneurs and owners of private companies).
- violence against women: although the legal framework has been considerably improved and penal policy and protection measures enhanced, women continue to suffer domestic violence and violence in intimate partner relationships, and about 40 women are killed in intimate partner violence annually. During 2013, 9877 victims of violence were registered in social welfare centers, which is an increase of 5.92% compared to 2012,
- although women MPs account for 30% of the national parliament owing to the quota, they are still significantly under-represented in executive positions, especially at the local level, in the positions of CEOs of public enterprises and institutions, in particular utility companies, women are least represented at the local community level and in the local community councils,
- the gender gap in education has been significantly reduced, approximately equal numbers of girls and boys attended and complete primary and secondary schools, women have accounted for 60% of the graduates since 2009. The gender gap is evident in educational profiles: women are more educated in the field of social sciences, while in technical and natural sciences men are a majority. Although women often hold master's and doctoral degrees, heads of higher education establishments and institutes and scientific - research institutions, especially in natural and technical sciences, are predominantly men.

- The majority of single parents, who constitute a very vulnerable segment of the population, are women,

Roma women, women with disabilities and rural women are in a particularly challenging and unfavorable position.

6.1.1. Gender equality in Municipalities of the Srem District

In the municipalities in the Srem District the institutional framework for gender equality is partially developed: in all municipalities and in the city of Sremska Mitrovica local gender equality mechanisms (Commissions) have been established, but they are not sufficiently active nor are they visible in the system and activities of local self-governments.

Women are present in decision-making positions in line with the average for Serbia. The lowest number of women refers to women in municipal councils and at the helm of public enterprises. There is only one woman who is the president of the municipality (Pećinci), and there is a total of 9 female presidents in Serbia out of 169 municipalities.

There are no women in the position of energy manager, which reflects the gender stereotype according to which the energy issue is a technical issue, and thus a traditionally male field.

Table 22 provides an overview of key gender equality indicators in relation to decision-making in local self-government in Srem.

Table 22 - Key gender equality indicators in decision-making – Srem District

Municipality	Local GE mechanism	President of Municipality	Municipal Council	Councilors total	Total women [%]	Energy manager
Inđija	Yes	M	11 members (5 women)	37	29.73%	-
Irig	Yes	M	7 members (no female members of MC)	20	25.0%	-
Pećinci	No	F	-	30	33.33%	-
Ruma	Yes	M	11 members (3 women)	43	32.5%	-
Sremska Mitrovica	Yes	M	11 members (2 women)	61	31.15%	-
Stara Pazova	Yes	M	13 members (2 women)	48	27.08%	-
Šid	Yes	M	11 members (3 women)	39	30.76%	-

Local development strategies do not feature the principle of gender equality. Appendix 4 provides an overview of employment status in public enterprises in the Srem District.

6.1.2. Economic Activity of the Population

Serbia is characterized by a very low activity rate of the population, especially among women, which points to unregistered work in the grey economy and a widespread failure of women to access the labor market. Table 23 shows data on working status of the population disaggregated by sex, for the level of Serbia[3].

Table 23 – Republic of Serbia: data on working status of the population disaggregated by sex

	Unit	Total	Men	Women
Active population		2853245	1614538	1238707
Employed persons		2198200	1264734	933466
Unemployed persons		655045	349804	305241
Non-active population		1777237	687385	1089853
Activity rate	[%]	61.6	70.1	53.2
Employment rate	[%]	47.5	54.9	40.1
Unemployment rate	[%]	23.0	21.7	24.6
Inactivity rate	[%]	38.4	29.9	46.8

The differences between men and women are lower when it comes to rates of employment and unemployment, while the inactivity rate is considerably higher than the inactivity rate among men.

On the basis of data from the 2011 Population Census (the most recent data available for the level of cities and municipalities), the percentage of employed women in the Srem District– 44.9% is lower by around 10% compared to the average for the Republic, were women account for 45.9% of employed persons – table 24.

Table 24 – Srem District sex disaggregated data on employees

Municipality	Employees	o/w women [%]
Inđija	9283	46.0
Irig	1247	44.8
Pećinci	3374	45.0
Ruma	10106	41.1
Sremska Mitrovica	15230	49.0
Stara Pazova	12805	43.8
Šid	6305	41.3

The share of women in the number of unemployed persons is the highest in Sremska Mitrovica, and the lowest in Ruma and Šid[4].

[3] Labor Force Survey, 2013; RZS, Belgrade, 2014.

[4] These differences can be reviewed in more detail by examining prevailing industries and largest employers in municipalities.

6.1.2.1. Agriculture

Inactivity rates in Serbia are high, and have been on the rise since 2010. Inactivity is especially prevalent among women.

The largest number of employees in Serbia work in agriculture, namely 21% of all employed women and 23% of all employed men. Women are unpaid family workers/ supporting household members three times more often - 13% of women as opposed to 4% of men (above the age of 15). Women account for 68% of all unpaid family workers/ supporting household members.

Table 25 – Persons working in agricultural holdings, by sex

Municipality	Total of agricultural holdings			Family farms			Legal entities		
	total	women	men	total	women	men	total	women	men
Inđija	6 668	2 576	4 092	6 342	2 493	3 849	326	83	243
Irig	3 099	1 253	1 846	2 987	1 233	1 754	112	20	92
Pećinci	7 132	2 944	4 188	7 023	2 929	4 094	109	15	94
Ruma	11 302	4 583	6 719	11 007	4 531	6 476	295	52	243
Sremska Mitrovica	15 729	6 216	9 513	15 214	6 111	9 103	515	105	410
Stara Pazova	6 935	2 641	4 294	6 695	2 574	4 121	240	67	173
Šid	9 149	3 648	5 501	8 776	3 529	5 247	373	119	254
Republic of Serbia - TOTAL:	**1442628**	**615382**	**827246**	**1 416349**	**608697**	**807 652**	**26 279**	**6 685**	**19 594**

Table 26 – Regularly employed labor force and family members working on holdings

Municipality	Family members working on holdings			Regularly employed labor force on family holdings		
	total	women	men	total	women	men
Inđija	1 501	929	572	8	-	8
Irig	3 926	2 503	1 423	5	-	5
Pećinci	3 926	2 503	1 423	4	1	3
Ruma	5 577	3 561	2 016	24	11	13
Sremska Mitrovica	7 895	5 045	2 850	13	3	10
Stara Pazova	3 095	2 029	1 066	4	1	3
Šid	4 369	2 783	1 586	14	1	13
TOTAL	**797199**	**501487**	**295 712**	**1 785**	**264**	**1 521**

Most family farms (69%) have 1-2 regularly employed labor force or a family member working on the holding– table 26. Women are strikingly less frequently regularly employed labor force on holdings. Information about the employment status of women was not available so it is possible to assume that women in the status of unpaid family workers/supporting household members are unemployed, which strongly affects their social vulnerability and insecurity. It is also possible to observe that women are more frequently regularly employed labor force on holdings with several hired workers, which shows that socio-economic status of women members of agricultural holdings is also linked to financial capacities of households.

The most recent agricultural census has shown that women are holders of farms on 17% of agricultural holdings, while according to the 2008 data 28% of holdings were registered in names of women, meaning that their share has significantly declined– table 27.

Table 27 – Holders of family holdings

Municipality	Total	Men	Women	Women [%]
Inđija	3 150	2 631	519	16.47
Irig	1 481	1 177	304	20.05
Pećinci	3 093	2 668	425	13.74
Ruma	5 406	4 447	959	17.73
Sremska Mitrovica	7 306	6 243	1 063	14.54
Stara Pazova	3 596	3 052	544	15.12
Šid	4 393	3 648	745	16.95
R. Serbia - TOTAL:	617 365	510 419	106 946	17

Women are holders of farms with smaller areas of arable land, only 10.7% of holdings with more than 50 ha is registered to women, compared to 22% of farms with 1 ha of land or less - table X7.

On the basis of secondary data of the Statistics Office of the Republic of Serbia (for municipalities in the Srem District) from the standpoint of gender equality in the production of biomass it is possible to notice several issues that are relevant:

1. Women are holders of agricultural holdings to a much lesser extent, and to those with larger area of land to the least extent, since the production of biomass in significant quantities is determined by the size of arable land, *inter alia*, it will be much more difficult for women to start such production on smaller farms. Therefore, a solution could be either an association of women or purchases by larger producers. If agricultural producers who have more area of land were provided subsidies or incentives for production (use) of biomass, it would be necessary to examine required forms of incentives for women, small producers, in some other branches of agriculture, such as organic farming, vegetable growing, extensive varieties, etc.
2. Women are much more likely to be unpaid family workers/supporting household members, and they are much rarely permanently regularly employed labor force on the holding, which directly affects their social security and exclusion, especially at old age. Project activities can be partly focused on raising awareness of the holders of holdings about the employment importance and opportunities for women (family members) on the farm. Also in the case of increasing workload and the type of work related to the production and use of biomass it is necessary to consider the specificity of women's involvement.

Table 28 – Agricultural holdings (by area of land used)						
Municipality	**Land area in [ha]**					
	≤ 1	**1,01–2**	**2,01–5**	**5,01–10**	**10,01–50**	**50<**
Number of households	179 872	121 058	178 919	87 490	44 506	5 520
Women holders of holdings [%]	22.0	19.4	15.8	12.1	10.0	10.7

From the standpoint of special projects dealing with this topic it would be necessary to examine the differences in the levels of awareness and knowledge among men and women regarding the possibilities for production and use of biomass. Also, for the same purpose, it would be necessary to collect the following information:

- Participation of women and men in project meetings in municipalities
- Managers of relevant public utility companies, by sex
- employed in the public utility companies in the production and distribution of energy by sex
- customers and/or employees working in the facilities envisaged heating on biomass, by sex (depending on the solutions proposed by the municipality)
- energy managers in municipalities, by sex

It is necessary to examine the identified barriers to the production of biomass, from the literature, practices at the global level, in order to determine whether there are gender-relevant aspects of these barriers (knowledge, skills, information, etc.).

In the preparation of plans, policies and strategic programs aimed at providing incentives for the production of biomass at the community level it is necessary to examine the effects on food production, especially in small agricultural holdings.

Defining gender-sensitive indicators for monitoring the socioeconomic effects of production and use of biomass is crucial for understanding the gender-related risks.

7. Conclusion

By its very nature, the development of agricultural activity and increased utilization of available biomass can stimulate economic activity in the entire district. In a large number of cases the generation of heat and/or electricity from biomass can create new jobs, reduce energy dependence on imported fossil fuels, reduce energy costs and properly promote the sustainable use of natural resources. According to some estimates made on the basis of successfully completed projects in the world, 60-70% of the money invested in the purchase of biomass as an energy fuel indirectly returns and stays in the local community, which is significantly more compared to 10-15% of the funds that remain for the local economy in purchases of fossil fuels.

Despite the undeniable available resource capacities in the territory of the Srem District there definitely exist objective obstacles to the implementation of this type of projects. In the territory of the Srem District biomass is already collected in an organized manner and used for heat production. So far, mainly private companies have been involved in organized collection of biomass, which have identified a clear financial interest in this business. In any case, the already mentioned examples of good practice in this field in the territory of the Srem District are certainly praiseworthy.

Available quantities of biomass in a particular area do not necessarily lead to the implementation of projects of this type. For each individual case, it is necessary to carefully and thoroughly examine the technical aspect of project implementation first and foremost, and then the economic feasibility of the intended project. On the other hand, the public sector is faced with objective problems primarily in the implementation of certain projects of this type. The implementation of projects in which the biomass is used for energy-related purposes in many cases means that in addition to the main investment in energy equipment it is necessary to also purchase new equipment for preparation of biomass and its transport. Even where there is both technical and economic justification for the implementation of such projects, it is often not easy for local communities to secure funding for the project (obtaining guarantees, high interest rates indexed to the euro, high costs of loan approval and servicing).

We should not forget the fact that almost all municipalities of the Srem District have access to energy infrastructure in terms of supply of electricity and natural gas. In some municipalities the majority of public facilities is either already connected to the distribution system for supply of natural gas, or to the district heating system, in municipalities where it exists. Also, the price parity between electricity and other energy sources is one of

the reasons for the fact that projects for generation of heat and/or power from biomass are not yet (*translator's note: the end of the sentence is missing in the Serbian original).*

Biomass is often spread over a large area in relatively small quantities, and strong logistical support is therefore necessary for collecting and storage of biomass. Also, it is essential to the realization of this kind of project to ensure continuous collection of biomass during a number of years and thus providing security of supply of biomass. An obvious shortcoming prevailing in the entire territory of the Republic of Serbia is the fact that there is no established market for agricultural biomass. In many cases, municipalities are not able to provide this type of support.

In conclusion, the Srem District has all the prerequisites for the use of biomass for energy-related purposes: good road and waterway infrastructure, in most municipalities the urban part of the settlement is located very close to agricultural land, which greatly mitigates logistical problems in terms of collecting and transporting biomass. Good yields of cereal crops in this terrain as well as forestry potential in certain municipalities of the district guarantee improved security of supply of biomass compared to other regions of the Republic of Serbia. Also, already realized projects of heat production from biomass can serve as excellent examples to other stakeholders.

OPPORTUNITY STUDIES

OPPORTUNITY STUDY MUNICIPALITY OF PEĆINCI

The Municipality of Pećinci is considering raising an energy plantation on an area of 20 ha on the land whose user is JKP Sava (PUC Sava), and which is located in the area between Karlovčić and Deč. The distance to the district heating plant in Pećinci is approximately 17 km. The basic idea is to substitute the energy source which is now used as the primary fuel (natural gas) in the boiler room of the district heating system.

Energy plantations of broadleaf forests (poplar, willow, black locust and paulownia) with short life cycles (rotations), give a large annual yield of biomass per unit of plantation area. Plantations for the production of biomass can be planted on soils of varying quality and categories. These plantations are raised to produce large quantities of wood materials for generating energy.

Energy plantations are grown in cycles so that the first felling of trees is conducted after 3-5 years and then once in three years, with cycles having a maximum duration of about 20 years. After the felling, the wood stock is usually converted into wood chips (possible variants are producing pellets or generation of biogas), and thus, through direct combustion of wood chips of young plants (age 1-3 years), a significant amount of heat can be generated. Table M1.1 provides an overview of basic characteristics of different plantations used for this purpose.

Table M1.1 – Characteristics of different crops used in forming energy plantations

Characteristics	Description
Wood species	Willow: Salix alba and S. viminalis Poplar: Populus nigra, P.×euramericana cv. robusta, P. alba, P. tremula, P. balsamiferas, P. maximowiczii, P. Tomentosa and P. euphratica
Product	Biomass
Management objectives	Commercial production of biomass, plantations of fast-growing short rotation species of willow with regeneration from the root, plantations of short rotation one-cycle poplar, the maximum yield of biomass, plantation felling by using a „harvester“
Capital intensity	High
Labor intensity	Low, mainly control of weeds, diseases and undesirable plant species
Application of agricultural machinery	Highly mechanized
Technology	Selected planting material, fully mechanized planting and regeneration from the cut stump, adequate application of fertilizers, pesticides, fully mechanized planting and felling, necessary protection against fire (may take about 10% of the plantation area)

Table M1.1 – Characteristics of different crops used in forming energy plantations	
Characteristics	**Description**
Productivity	Very high
Environmental risks	Pollution due to the use fertilizers, pesticides, chemical weed control
Positive environmental impact	Improved quality of groundwater through adoption of nitrate (phytoremediation), sequestration of carbon dioxide in the root and soil
Infrastructural requirements	Relevant producers of bioenergy or wood briquettes, high level extension services and application of scientific findings
Potential companies	Medium-size and large companies
Source: Fischer et al., 2005 B.Klašnja et al.: Dense Poplar Plantations as the Raw Material for the Production of Energy. – Bulletin of the Faculty of Forestry, Belgrade, 2006, no. 94.	

Various scientific papers provide data on willow yield

- 10-12 t/ha (Strauss, Grado, 1997) in one-year willow plantation with 52,500 pc./ha,
- ≈12 t/ha (Dawson , Cracker, 1995),

and on the yield of the best poplar clones

- 15 t/ha (Jiranek and Weger, 1998), yield of the best poplar clones.
- 10 -12 t/ha (Jossart *et al.*, 1998), 10000 pc./ha
- 11.25 t/ha per year in a 9-year cycle, with annual felling and regeneration from the cut stump (Marković *et al.*, 1996), at plant density of 40,000 pc./ha

Energy plantations are usually limited in terms of time to around 20 years. There are no practical experiences for longer periods of use. The main costs and revenues during the mentioned period are:

- Costs for procurement of seedlings, cultivation and felling (harvesting), and
- Revenue from sales of woody biomass

Investment costs and revenues, unlike most other agricultural crops, occur at the same time during the year and/or at the end of the period of rotation. Of course, the exception is related to the first rotation up to the point of the first felling/harvest. For agricultural holdings with mixed perennial plantations or forest plantations a long-term investment period with relatively large capital investments is not unusual. On the other hand, considering sharp fluctuations in costs and revenues over a very long period of 20 years, no economic analysis can predict positive or negative results. The application of the margin calculation method should be avoided in making comparisons among different energy plantations, as well as comparisons with other methods of obtaining biomass. In this sense, it makes much more sense to compare total costs and revenue, taking into account the period of time, that is, the discounted value of money.

Table M1.2 presents two examples of calculations of investment costs applied to 1 ha of land:

- Example 1: energy willow plantation, the distance of up to 10 km, in a four-year rotation,
- Example 2: energy poplar plantation, with well-irrigated terrain, in a three-year rotation.

Table M1.2 - Investment costs estimate		
	Energy willow plantation	**Energy poplar plantation**
Adopted parameters:		
Land area:	1 ha	1 ha
Plant density/spacing:	13000 pc/ha	8000 pc/ha
Price (considering the quantity):	€0.09	€0.18
Rotation period:	4 years	3 years
Time period of the plantation:	20 years	21 years
Number of life cycles (rotations):	5	7
Average annual yield:	10.4 t/ha	11.6 t/ha
Mechanical felling costs:	20 €/t	20 €/t
Work of the harvester:	€600	€600
Cultivation costs	35 €/ha	35 €/ha
Transportation costs (10 km)	5 €/t	5 €/t
Cost of wood chips:	80 €/t	80 €/t
Discount rate	4%	4%
Investment in planting and maintenance:		
Land preparation	130 €/t	130 €/t
Crop protection	€50	€50
Total cost of the plantation	€1170	€1,440
Cost of seedling transport	€100	€100
Costs of planting	€650	€650
Transport of the planting machine	€150	€150
Cropping practices after planting 2x earthling up + 2 x herbicides	€180	€180
Total investment costs:	€2430	€2450
Costs after 1 planting	€0	35 €/ha
Other costs		
Land re-cultivation:	€1000	€1000
Annual overhead costs:	€100	€100
Costs for premises (rental) per year:	€200	€200
Costs of risk:	€20	€20
Source: Anlage und Bewirtschaftung von Kurzumtriebsflächen in Baden-Württemberg. -- Ministerium für Ländlichen Raum, Ernährung und Verbraucherschutz Baden-Württemberg		

Likewise, according to the data of companies operating in the territory of the Republic of Serbia the cost of starting a plantation energy willow range from 1800 to 3200 €/ha (Source: http://www.rebina.rs/salixViminalis/).

Table M1.3 shows adopted parameters shared values for calculation.

Table M1.3 – Adopted parameters for calculation			
	Unit	**Energy plantation**	
Mechanical felling costs:	[€/t]	20	20
Transport of the harvester to the location:	[€]	600	600
Cultivation costs	[€/ha]	35	35
Transportation costs (17 km)	[€/t]	5	5

For further calculations with respect to a **willow plantation** the following estimates have been adopted:

- Total area energy plantation: 20 ha
- Planting cycle: 20 years
- Number of life cycles: 5
- cost of starting a plantation of energy willow: 3000 €/ha
- plantation density: 15000
- costs of seedlings transportation: €600
- plantation price: 0.16 €/pc.
- lower calorific value: 18.4 MJ/kg
- initial investment in planting and maintenance: €1260
- average annual yield: 10.5 t/ha

For further calculations of **poplar plantation** the following estimates have been adopted:

- Total area of the energy plantation: 20 ha
- Planting cycle: 21 years
- Number of life cycles: 7
- cost of starting a plantation of energy willow: 3200 €/ha
- plantation density: 10000
- plantation price: 0.26 €/pc.
- costs of seedlings transportation: €600
- lower calorific value: 18.5 MJ/kg
- initial investment in planting and maintenance: €1130
- average annual yield: 11.4 t/ha

Table M1.4 shows the calculation results.

Table M 1.4 – Calculation results

		Willow plantation	Poplar plantation
Total plantation area	[ha]	20	20
First year capital investment:	[EUR]	61260	65130
Mechanical felling costs:	[EUR]	21000	31920
Transport of machinery:	[EUR]	3000	4200
Land cultivation costs after felling:	[EUR]	3500	4900
Transportation costs:	[EUR]	1050	1140
Additional investment:	[EUR]	0	4900
Re-cultivation of land:	[EUR]	1000	1000
Annual overhead costs:	[EUR]	2400	2520
Sum of costs calculated for the planting cycle:	[EUR]	31950	50580
Total cost:	[EUR]	93210	115710
Available amount of fuel in the planting cycle:	[t]	4200	4788
Amount of heat in the planting cycle:	[GJ]	77280	88578
	[EUR/GJ]	1.21	1.31

Past fuel consumption in the district heating system data je Table M1.5

Table M1.5 – Past fuel consumption in the district heating system			
	god	**2013**	**2006**
Gas price adopted for the calculation	[din./m3]		48.3
Natural gas consumption during the year	[m3]	400,000.0	302,235.0
	[GJ]	13,680.0	10,336.4
Pecuniary amount for gas consumption:	[Din.]	19,320,000	14,597,951
	[EUR]	159,669.4	120,644.2
	[EUR/GJ]		11.7
			20 years
Required amount of heat in the planting cycle:	[GJ]		273,600

The calculation is made without discounting the value of money. The investment costs do not include purchase of necessary equipment for felling/harvesting biomass and cutters, as well as the construction of the necessary storage space in the boiler room, or purchasing of a new burner or a new boiler.

By comparing the obtained values, it is obvious that the planned plantation area is not enough to fully substitute the fuels. According to some rough estimates, the required willow plantation should be 3.4 times larger, while the poplar plantation, based on the thus defined yields, should be about 3 times larger.

OPPORTUNITY STUDY MUNICIPALITY OF RUMA

The company *Gradska toplana* (City Heating Plant) in Ruma is a public enterprise to which the Municipality of Ruma has entrusted the provision of district heating services. It is the only public enterprise that performs this activity in Ruma. On the other hand, in the Municipality of Ruma there is a natural gas distribution network. Many houses and buildings are connected to the distribution network for natural gas distribution. The public enterprise has nine separate boiler rooms with the total installed capacity of 27 MWt. Out of the above total amount, 21 MWt is installed in heating system boilers, while another steam boiler whose power is 6 MWt has been installed. Eleven boilers (22 MWt) use fuel oil as fuel, while the remaining five boilers (5 MWt) use natural gas as the main fuel. Boilers that use fuel oil are located below the ground level, therefore they cannot use natural gas. Most boilers are older than 30 years, and some of them have as many as 35 years. Only the steam boiler is a bit "younger" - 20 years. JP *Gradska toplana* does not hold title to one of the boiler rooms, which houses a steam boiler with steam production of 10 t/h, and it works with the following nominal parameters: 6 bars and 170 ° C. The boiler room is located the *Rumen* factory compound and in the previous period it has supplied the factory with process steam. As the company ceased to operate in the meantime, the management of the boiler room was handed over to JP *Gradska toplana,* since this boiler room supplies residential buildings with heat for heating. The *Rumen* factory was privatized and it is an open issue whether the new owner will want to continue to supply heat to the surrounding buildings.

The Tivoli settlement is the only consumer of heat that is connected to the Rumen boiler room. The total area of heated space in the Tivoli settlement is 2130 m^2.

The installed capacity of heat consumers in the Tivoli settlement is 3.2 MWt. On the other hand, the heat capacity of the boiler in the *Rumen* boiler room, during work in the winter, is higher than 4 MWt. Such large consumption is disproportionate to the above heated area, and the reasons for this kind of discrepancy lie in the fact that the heating pipeline is extremely long, oversized and poorly insulated (huge losses in the distribution of heat), perhaps also due to poor insulation of external walls of buildings. An additional problem is the low ratio between the installed capacity of the boiler and the need for heat, because the boiler in the boiler room *Rumen* operates at the maximum intensity of 50-60% of installed capacity.

This small boiler room with the steam boiler is old and unreliable because there is no spare boiler or pump. Yet another problem is the large distance of the boiler room from consumers. The nearest residential building that is connected to this boiler room is located at a distance of 1.5 km - figure M2.1. Four heat substations are connected to the *Rumen* boiler room. These substations are older than 30 years, and manually regulated.

In the Municipality of Ruma there is a plan to replace the old boiler room with a new one, and to use biomass as fuel in that new boiler room.

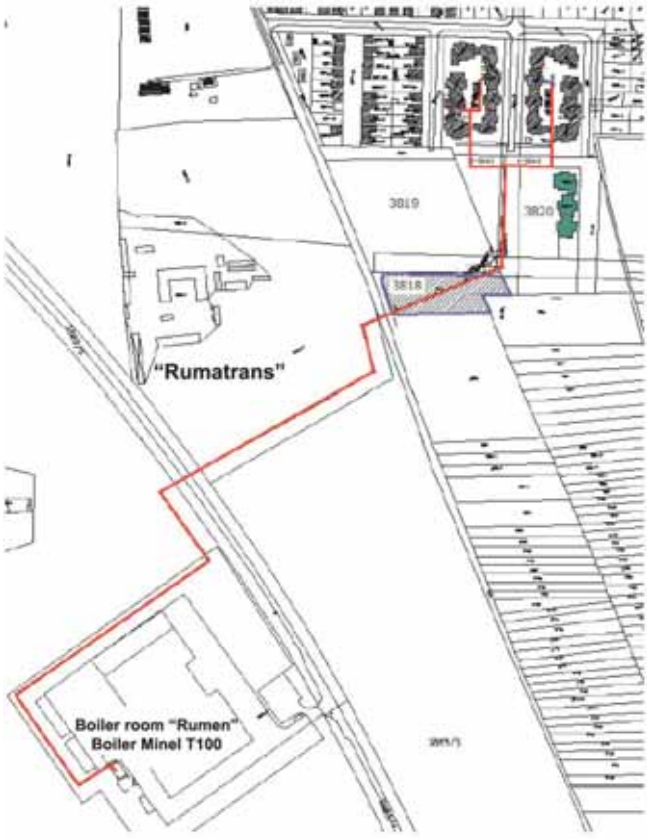


Figure M2.1. – The existing boiler room *Rumen* [Project - Promotion of Renewable Energy Sources and Energy Efficiency. -- EuropeAid/129768/C/SER/RS; Contract no. 10/SER01/26/21. -- Republic of Serbia: Subtask B2.2 Pre-feasibility studies for construction of CHP plants District heating company in Ruma]

Supply of biomass

The management of the PE assumes that sufficient quantities of agricultural biomass can be obtained in the surroundings of Ruma to feed a boiler on biomass. The potential source of biomass supply is straw 15000 t/a (4500 ha of arable land).

Settlement Tivol – heat consumption

Table M2.1 provides an overview heat consumption of the Tivol settlement.

Table M2.1 – Basic information on heat consumption of the Tivol settlement					
Number of planned housing units	Number of constructed housing units	Total heating surface	Capacity of heaters	Specific heat flux	Total consumption (fuel oil)
		[m^2]	[kW_t]	[W/m^2]	[t]
1200	400	2130	3182	149	450

Replacement of existing sections of the heating pipeline with a diameter of DN 300 with pre-insulated DN 125 heating pipes is no major investment because the existing sections of the heating pipeline are laid in a concrete channel, and considering that no construction works are involved (excavation, backfilling and asphalt paving). Necessary works include the removal of the existing pipeline and installation of two new sections of DN 125 pipeline with a diameter of 2k200m. The costs of the replacement of the existing pipeline are estimated at €26400.

Estimated costs for the purchase and installation of new automated substations (including fitting and transportation) amount to €57,946.

Purchase of two circulator pumps (one working and the other spare pump) to ensure the circulation between the boiler room and the substations. According to the estimate, the price of each pump is €3600.

The external design temperature for the Municipality of Ruma is -15°C. The number of degree days for the closest weather station (Sremska Mitrovica) is 2740.

The following estimates have been adopted for the efficiency level of solid fuel:

- η_k=0,8 –boiler efficiency level
- η_c=0,98 – efficiency level of a new pipe network
- η_r=0,95 - efficiency level of a new pipe network
- η = 0,752 – the overall level of efficiency
- Lower calorific value of straw: 14400 KJ/kg

According to the calculations, the annual required amount of biomass is

- Required amount of straw: 110.2 t/a; According to the survey, which was conducted in 30 households from 10 villages of Ruma, which are located at a distance of 30 km from the boiler, and conducted by the Regional Development Agency Srem 2012, the amount of biomass available is several times greater than the required amount (generally available corn biomass in the amount of 2,295.2 t / yr. and 1000.2 t / year of biomass of wheat and other crops).
- Calculated value of boiler power: 3.66 MW
- The price of the boiler according to the nominally adopted price: €683,000
- Total costs excluding construction works: €770,946

OPPORTUNITY STUDY APPLICATION OF BIOMASS IN PUBLIC FACILITIES

A frequent case of the use of biomass in the entire territory of the Republic of Serbia is related to schools which are branch departments of parent schools and are located in smaller places. As a rule, these are smaller buildings, which as often as not also serve as preschool institutions and primary schools. These are usually relatively old buildings that have not been maintained properly for a number of years. The advantage of such facilities in terms of the use of biomass lies in the fact that such facilities are located in the immediate vicinity of "biomass sources", irrespective of whether it is forest or agricultural biomass. On the other hand, since these are smaller places, it happens very often that these places do not have infrastructure which is available in larger towns (no connections to the gas grid and there is no centralized system for supply of heat). When the implementation of such projects commences, it is usually an opportunity to further improve the quality of occupancy in these facilities or the comfort of heating in them. Such effects are achieved by simultaneous insulation of the ceiling or the roof structure, replacing dilapidated windows, insulation of exterior walls, and other measures that do not directly affect the reduction of energy consumption, but rather contribute to the general improvement of living and working conditions in such facilities. In the following section, one such project will be presented that was successfully implemented in the Republic of Serbia through joint investment by donors and the municipality in which the facility is located.

That is precisely the reason why this study presents one of the typical cases in which firewood was used in the traditional manner before the implementation of the project, by combustion in furnaces at several places in the facility. The basic idea was to reduce energy consumption in the building, before the installation of a centralized boiler room and a pipe network with radiators, so the following energy efficiency measures were envisaged as part of the project:

- insulation of attic space,
- insulation of external walls,
- replacement of exterior doors and windows.

The calculation of heat losses is made upon the implementation of energy efficiency measures, for the following conditions:

- The external design temperature: -20 °C,
- Position of the facility: normal, but exposed to greater influence of the wind
- Suspension of heating: 15 h in a day,
- Working fluid: hot water 90/70 °C,
- Boiler room: heating pipeline system 90/70 °C,
- Boiler: fueled by bulky wood waste and wood briquettes,
- Pipe network: made of black seamless pipes, corrosion-protected,
- Regulation: initial water in the system of radiator heating as a function of the outside air temperature,
- System of protection: boiler protection against low-temperature corrosion (cold end of the boiler)
- Stack: of a proper cross section,
- Total area of the facility – figure M3.1: 442.76 m^2
- Required amount of heat: 65,661 W
- Choice of a boiler according to the calculated value of the heat quantity: 65,661 W:
  - Capacity of a wood waste boiler is increased by 20% due to the suspension of heating - adopted parameter for the boiler using wood chips and wood briquettes: 80 kW
  - Boiler efficiency: 75%
  - Lower calorific value of wood and wood waste is
    H_d=19200 - 217xW = 19200-217x30 = 12690 KJ/kg
    W = 30% - влажност дрвета
  - Required amount of wood to feed to a 80 kW boiler:

$$B_h = \frac{3{,}6 \cdot Q_h}{\eta_к \cdot H_d} = 30{,}3 \text{ kg/h}$$

Bill of quantities

- Radiator heating and pipe network in total: €6484.6
- Boiler: €2945.3
- Boiler room: €7051.4
- Other works: €1185
- Total costs: €17666



Figure M3.1. - Facility floor plan

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