



## UTILIZATION OF WASTE MATERIALS FROM BIOMASS AS ENERGY-GENERATED PRODUCT IN TECHNOLOGICAL PROCESS

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### ABSTRACT:

Climate changes, energy dependency and reduction of fossil fuels lead to great public interest and utilization for renewable energy sources (RES). Demand for renewable energy is consequence of global energy crisis and fact that utilization of solar energy, geothermal energy, eol energy and energy of biomass reduces pollution to environment.

EU and USA are intersted in overall energetic balance, energetic effiencie of thermal plants powered by biomass, rationalization of standard fuel dissipation in agriculture and higher level of environmental protection

These paper analyzes possibility for utilization of waste materials from fabricated fruit as energy-generated product for producing heat in technological process.

### Key words:

renewable energy sources, biomass, energy efficiency.

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## 1. INTRODUCTION

Consequences of climate changes, energy dependency and reduction of fossil fuels lead to great public interest and utilization of renewable energy sources (RES). Serious interest for renewable energy is the consequence of global energy crisis, but also fact that with usage of Solar energy, wind energy, geothermal water and biomass energy, nature and environment are far more less contaminated. Energy crisis that was engendered at the beginning of 2009. when the conflict between Russia and Ukrain started, lead to energy crisis in the most parts of Europe.

## 2. RENEWABLE ENERGY SOURCES (RES)

Renewable Energy Sources (RES), are offering great potential for future energy consupcion, but costs for energy production at these moment are to high.

Therefore it must elapse some period of time before it reaches new dimension of RES appliance. Unfortunately at these moment, human kind must rely on nonrenewable energy sources – oil, coal, nuclear energy and natural gas. RES without hydroenergy, provides about 1% of total energy at these moment. In the environmental approach, future rate must be significantly enlarged, because nonrenewable energy sources are decreasing every day. Development and appliance of RES (especially wind energy, Solar energy and biomass energy) are very important in many different ways. RES have very important role for decreasing CO<sub>2</sub> emissions in atmosphere. With increasing usage of RES, energetic system sustainability is getting more progressive and dependency from importing energy resources and electric power reduces [4].

Towards data that are shareware to public and national statistical database, oil consupcion in the world amounts about four billions of tons per year, while on the another hand total oil reserves amounts about 120 – 160 billion tonnes. Oil refinement will achieve peak by 2010. year, and there is the fact that fossil and nuclaer fuels offer only short time and nonrenewable development. Fossil fuel reserves are disappearing very fast, in this way many peple predicts two decades before everyone must use RES.

Members of EU have been decided to increase share of RES from 8.5 % in 2005. to 20% by 2020.

EU actions in field of RES lead to higher number of employed people, more than 350.000, and annual transactions are estimated to 30 billions €. World energy consumption by data for year 2000. (TPES – Total Primary Energy Supply) by RES is about 13.5. %.

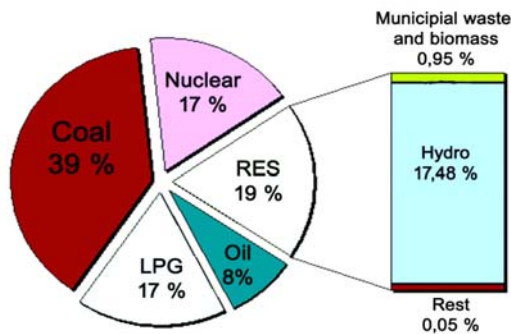


Figure 1. RES share in world electric power production

electric power, because it reduces dependency growth from importing energy. RES are separated to:

*Classic RES:*

- ✚ Combustible renewable waste (solid biomass, woodcoal, agricultural and animal waste, municipal and industrial waste, biogas) and
- ✚ Hydroelectric power plants.

*New RES:*

- ✚ Small hydroelectric power plants,
- ✚ Geothermal energy,
- ✚ Solar energy,
- ✚ Wind,
- ✚ Energy of see (sea, tide and low tide, thermal gradient).

But in wider sense RES means:

- ✚ Water power energy,
- ✚ Solar energy,
- ✚ Wind energy,
- ✚ Geothermal energy,
- ✚ Oceans and see energy,
- ✚ BIOMASS energy.

### 3. BIOMASS AND WASTE BIOMASS (WBM)

Biomass is organic matter from animal or herbal origin, which converts in many different ways to useful energy.

Energy from herbs represents acumulated solar energy wherewith light is transforming to chemical energy.

Biomass constitute from agriculture waste 98%, forest production 1,5% and wood refining production 0,5%. On the another side biomass can divide to energetic plants, agricultural scrap and waste. Biomass waste from agricultural production is one of the most perspective energy sources in Serbia and beside that biomass do not generate hazardous substances. Seizing of biomass from waste as a fuel can save considerable funds which strive in purchasing of all other energy-generating products.

Biomass and waste materials are utilizing as energy sources for their combustion and heat generation which propel electric generators or for fluid heating. Energy acumulated in biomass is chemical nature so in energy exploitation, there is no work [1].

Biomass energetic potential is enormous and it amounts about 80% of total RES potential. That is the energy which is equivalent to 2,6 millions of tons of combusted oil. Technological advance lead to development in technologies which are based on biomass waste, energy and resources that agroindustrial complex unload, but also and all other areas of agricultural development. In the same time, introducing with new technologies shows pozitive impacts on the environment, apropos to environmental protection and improvement. Available biomass in Serbia could be energetic source for unrenewable liquid and gas fuels replacement, so as for electric energy in agroindustrial complex[7].

#### 4. „VINO ŽUPA“ EXAMPLE

Energy-generating products that are using at the moment in the fabric complex „VINO ŽUPA’ - DD“ are heavy fuel oil – mazut and electric energy. Because of constant fossil fuel price changes and obtaining instability, usage of biomass as energy-generating product is reasonable in economic and ecological aspect.

Biomass from waste (WBM), which emergent in agricultural products treatment in fabric „Vino Župa”-Aleksandrovac, management plans to use as motor fuel for biomass boiler which is in instalation phase.

WBM in the case of “Vino Župa” (seeds, stems, apple and grape rapes and wood waste), belong to RES and CO<sub>2</sub> neutral energy sources.

As a fuel in biomass boiler, waste materials from fruits and vegetables production are estimated:

Table 1. Estimated fruit and vegetable production

Name	H- humidity [%]	Quantity	Period
Wood waste and sawdust	40	20 m <sup>3</sup> /day	from 01.06.-31.10.
Cherry seeds with foreskin	49	1000 t	from 01.06.-30.06.
Cherry, plum, peach, apricot seeds with foreskin	49	1000 t	from 01.07.-31.07.
Cherry, plum, peach, apricot seeds with foreskin	49	500 t	from 01.08.-31.08.
Apple slurry	84,61	10000 t	from 01.08.-31.10.
Grape rape	50,20	2500 t	from 10.09.-20.10.
Grape stem	60	2500 t	from 10.09.-20.10.

Table 2. Boiler technical characteristics

Type	SURI P -12/SURI-RGF 15
Production max.	12000 kg/h
Boiler capacity	7812 kW
Max. Preasure	13 bar
Tested preasure	16.9 bar
Max. steam temperature	195 °C
Feeder water temp.	105 °C
Fuel	Biomasa
Lower fuel heat potencial (W=40%, A=0.5%)	9908.22 kJ/kg
Boiler efficiency rate	82.57%
Exit flue gases temperature	161 °C
Boiler mass – net	47831 kg
Boiler mass – fatigue	73756 kg
Heating area	900 m <sup>2</sup>
Preasure fall on the gas phase	1600 Pa
Preasure fall on the water phase	0,1 bar
Fuel consumption	kg/h 3437
Air flow	15880 m <sup>3</sup> /h
Flue gases flow on t <sub>exit</sub>	36150 m <sup>3</sup> /h

Towards data from study of Innovation Centre of Technical Faculty in Belgrade, accessible quantities of biomass are totally appeasing requirements for technological dry saturated steam production with 12 t/h and 12 bar.

Table 3. Average biomass heat potencial

Biomass	kJ/kg	9908
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## 5. CONCLUSIONS

So far „Vino Župa” was utilized mazut as a fuel which led to creation of gases that polluted air and environment and contributed to Greenhouse effects.

Since fuel price varied in last couple of years, boiler with biomass satisfied both ecological and environment aspects. Economical calculations point that boiler will be redeemed for couple of years with current prices of oil and production trend.

That confirms conclusion that biomass is economically payable, but only in cases when biomass was generated in big volumes next to direct exploitation presence.

With examination of analysis we can conclude that there is a strong connection between Strengths and Opportunities for maximum RES utilization as energy-generating product. But also it is essential to benefit from Strengths and Opportunities so we could eliminate Weaknesses and Threats.

Corresponding to global trend and requirement for energy, RES has future in resolving ecological and economic world crisis[3].

Table 4. SWAT analysis

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>✦ Low-cost resources – low redemption price</li> <li>✦ Non load waste to environment</li> <li>✦ Good expert sense</li> <li>✦ Good liquidity and profitability</li> <li>✦ Developed technology</li> <li>✦ Production Innovation</li> <li>✦ Biomass is CO<sub>2</sub> neutral fuel</li> <li>✦ Accessibly</li> <li>✦ “Clean” ash</li> <li>✦ High total energy potential</li> <li>✦ Employing</li> </ul>	<ul style="list-style-type: none"> <li>✦ Low fuel power</li> <li>✦ Transport</li> <li>✦ High humidity rate</li> <li>✦ Low energy value by mass unit</li> <li>✦ Different admixtures (Chlor)</li> <li>✦ unhomogeneity</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>✦ EU access</li> <li>✦ EU strategy for RES – until 2020.year 20%</li> <li>✦ World trends</li> <li>✦ Energy crisis</li> <li>✦ 20 boiler producers in Serbia</li> <li>✦ Lower dependency from import</li> <li>✦ Equally and renewable country development, regions development in Serbia and dedication of local communities</li> <li>✦ Agricultural development</li> <li>✦ Cogeneration and threeneration</li> <li>✦ Renewable developmnet</li> </ul>	<ul style="list-style-type: none"> <li>✦ Law regulations</li> <li>✦ Undeveloped public sense</li> <li>✦ Unfriendly political an economic situation</li> </ul>

## LIST OF REFERENCES

- [1] Brkić, M., Janić, T.: Mogućnosti korišćenja biomase u poljoprivredi, Zbornik radova sa 2. savetovanja: „Briketiranje i peletiranje biomase u poljoprivredi i šumarstvu”, Regionalna privredna komora Sombor, Sombor, 1998., s. 5 – 9.
- [2] Dejan Krstić., Natalija Trivković, Radomir Brzaković, Industrijska eksploatacija biomase, festival kvaliteta 2007, 2. Nacionalna konferencija o kvalitetu života, Kragujevac, 08-11.maj 2007
- [3] Projektni zadatak za izradu glavnog mašinskog projekta parnog kotlovskeg postrojenja na biomasu., Fabrika kotlova“Kirka Suri“, Beograd, februar 2008.
- [4] Report from 2<sup>nd</sup> Workshop for Decision Makers, Project title: Virtual Balkan Power Centre for Advance of Renewable Energy Sources in Western Balkans, December 2006.
- [5] Rezime za donosiocje odluka, 9. zasedanje Radne grupe III Meduvladinog panela za promenu klime ,Bangkok, Tajland, 30. april - 4. maj 2007.
- [6] Studija: „Potencijali i mogućnosti briketiranja i peletiranja otpadne biomase na teritoriji pokrajine Vojvodine”, Poljoprivredni fakultet, Novi Sad, decembar 2007.
- [7] Tešić, M., Igić, S., Adamović, D.,Proizvodnja energije - novi zadatak i izvor prihoda za poljoprivredu, Savremena poljoprivredna tehnika Cont. Agr. Engng. Vol. 32, No. 1-2, p. 1-131, Novi Sad, januar 2006
- [8] Zubac, M.: Praktična primena tehnološkog postupka valorizacije biomase u energetske svrhe, Revija agronomska saznanja, JNDPT, Novi Sad, 20[07. br. 5, s. 58-62,
- [9] Sajt Evropskog peletnog centra,: [www.pelletcentre.info](http://www.pelletcentre.info),
- [10] Sajt Ministarstva poljoprivrede Republike Srbije, Beograd,: <http://www.minpolj.sr.gov.yu/>
- [11] <http://www.biomasa.hr/index.php>
- [12] [http://www.energyquest.ca.gov/story/chapter10\\_flash/biomass.swf](http://www.energyquest.ca.gov/story/chapter10_flash/biomass.swf)
- [13] <http://www.eniteh.hr/modsklad.html>