INSTITUTE FOR NUCLEAR SCIENCES - VINČA

Laboratory for Thermal Engineering and Energy

Tel/Fax: +381-11-3443498 +381-11-2453670
E-mail: dejan2004@vinca.rs

AGRICULTURAL BIOMASS FOR ENERGY PURPOSES IN SERBIA

Dr Dejan Đurović

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SCOPE OF PRESENTATION

1. Introductory notes

- Why is RES important for Serbia ?

- Why biomass in particular ?

- Why focus on baled agricultural leftovers?

2. R&D Activities on Utilization of Baled Biomass (Agricultural Residues)

3. Industrial Application

4. Conclusions

Energy balance – Serbia

Mtoe	Dom. prod.	Import
Coal	7.823	0.802
Oil	1.122	3.099
Gas	0.405	1.391
Total primary energy consumption	16.192	

Final energy consumption	**Mtoe**	**9.252**
Industry		2.708
Transport		2.015
Households		4.529

Why is RES important for Serbia ?

Energy indicators:	Serbia	EU
Final energy consumption (toe/c)	0.86	2.39
Electricity consumption (MWh/c)	3.88	6.20
Final energy intensity (kg.oe/$)	0.67	0.19
Electricity intensity (kWh/$)	2.45	0.50

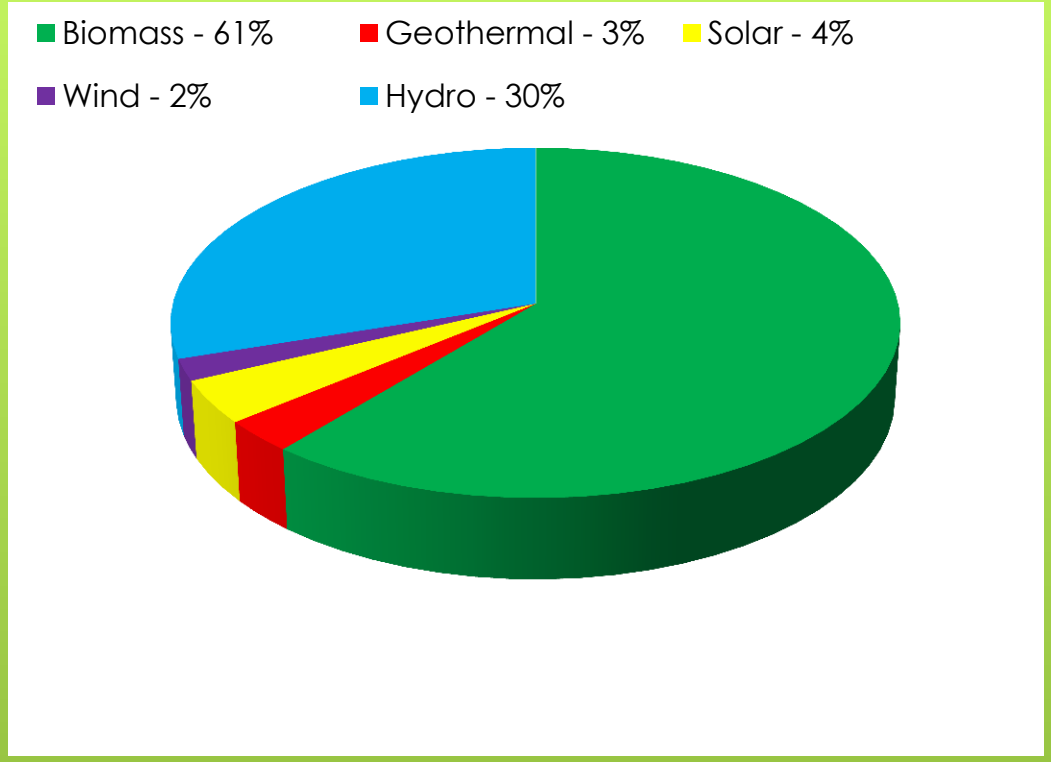
1 toe = 41868 MJ = 11.63 MWh

⇒ **energy consumption per cap. ~ 2-3 x less than in EU**

⇒ **3-5 x less efficient use of energy than EU**

⇒ **lignite is main domestic energy source (but reserves for only next ~40 years, <u>even if no new units</u>)**

⇒ **presently ~ 30% of energy consumed is imported**



Why biomass?

RES potential in Serbia

	Biomass	Hydro	Solar	Geot.	Wind	Σ
Mtoe	3.4	1.7	0.2	0.2	0.1	5.6

Quantities and energy potential of Solid Recovery Fuel (SRF) in Serbia

		2010	2015	2020
Quantities of SRF	t/y	828.000	922.000	1.180.000
LHV	kJ/kg	16.000	16.000	16.000
SRF for combustion	GWh/y	3.680	4.100	5.250
	toe/y	316.000	352.000	451.000
Potential electricity production from SRF	GWh_e/y	1.230	1.370	1.700

Why focus on baled biomass ?

Type	Structure	Energy pot. [TJ/year]	Total [TJ/year]
Woody biomass	Heating wood	10 000	approx. 43 000
	Wood waste after cutting	23 000	
	Wood waste from industry	2 800	
	Unofficial (illegal) cutting	6 700	
Agricultural biomass	**Farming**	**40 000**	**approx. 65 000**
	Orchards and vineyards	25 000	
		TOTAL:	approx. 108 000

Principles on Which R&D Activities Were Based On

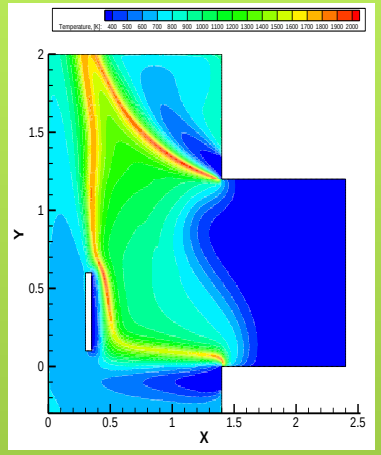
R&D, supported by Serbian Ministry of Science and Technological Development and also by a private boiler company, was based on following principles:

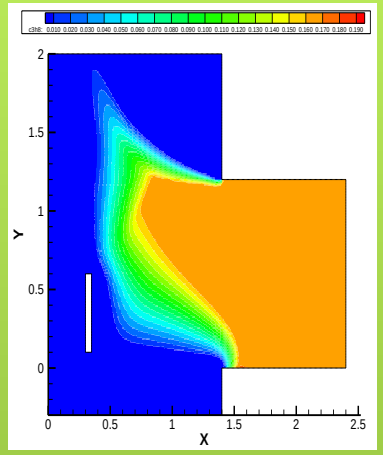
- **Technology has to be suitable for the most common agricultural biomass (residues collected on the fields in the form of bales).**
- **Technology should be consistent with capabilities of local industry,**
- **Technology should satisfy environmental norms.**
- **Energy efficiency has to be ≈ 85% for thermal plants, and ≈ 80% for CHP plants, similar to EU norms.**
- **Devices have to be simple and thus low cost, both in terms of low investments, self consumption and operation/maintenance costs,**
- **Logistic systems (for collection, transport, storage, ash management) should be developed at the same time.**

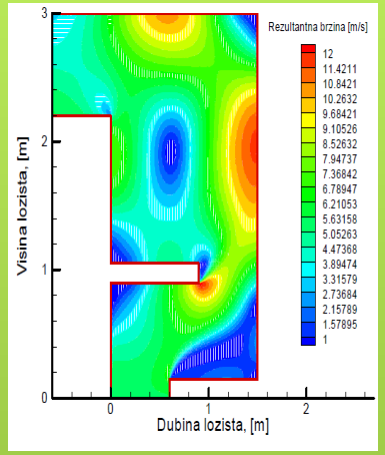
R&D Phases

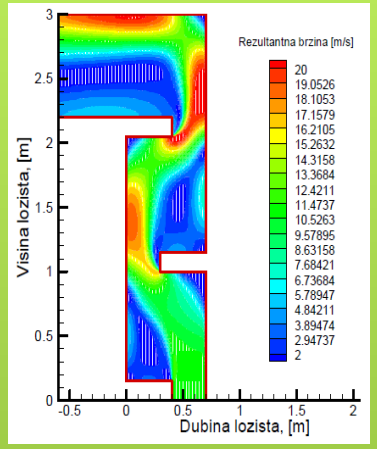
- Analysis of the operation data of the similar facilities;
- Laboratory investigation of the potential fuels;
- Investigation of combustion characteristics of potential fuels;
- Simulation of combustion in cigarette combustion furnaces, in order to optimize of the furnace dimensions;
- Construction and testing of the experimental facilities, first small then industrial-scale, for the purpose of obtaining project parameters and correction of the mathematical models;
- Development of the methodology for heat accumulator calculations;
- Development of the automatic control software;
- Construction of the hot-water boiler, designed for industry, demonstration, and experiments, power of 1.5 -2 MW;
- Detail testing of the boiler.

R&D Highlights



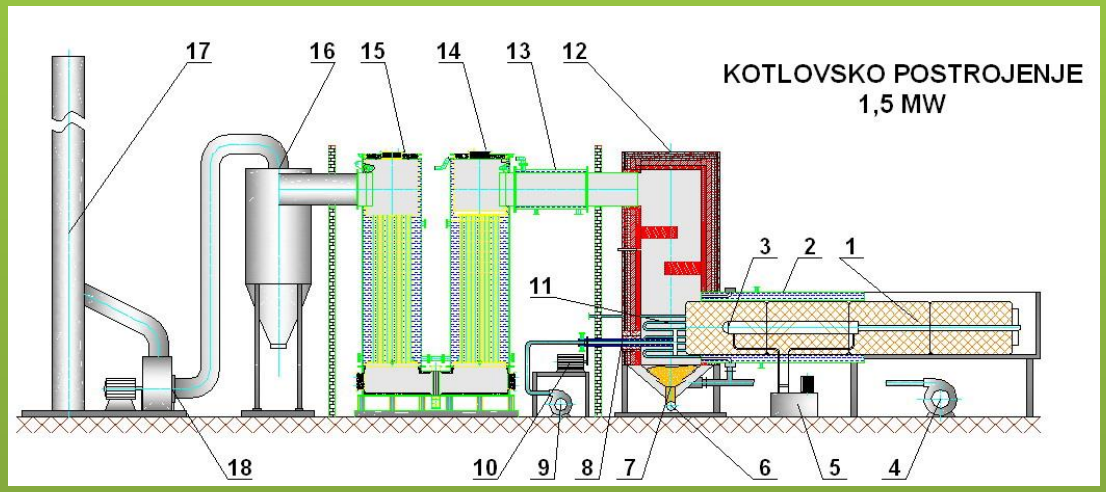






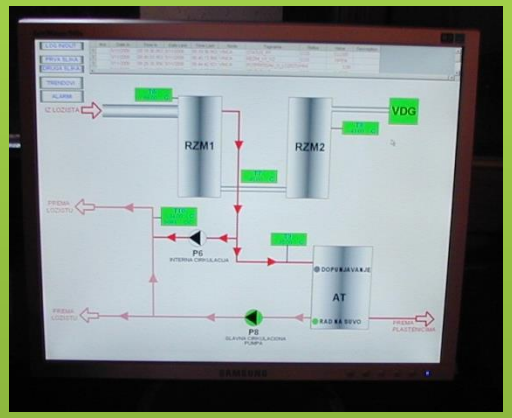
Results obtained by own developed models. Used for obtaining furnace dimensions and optimization of working parameters.

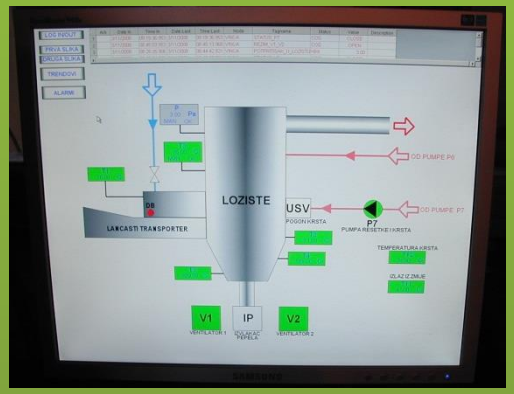
Experimental facility



Scheme of an industrial unit

Industrial prototype

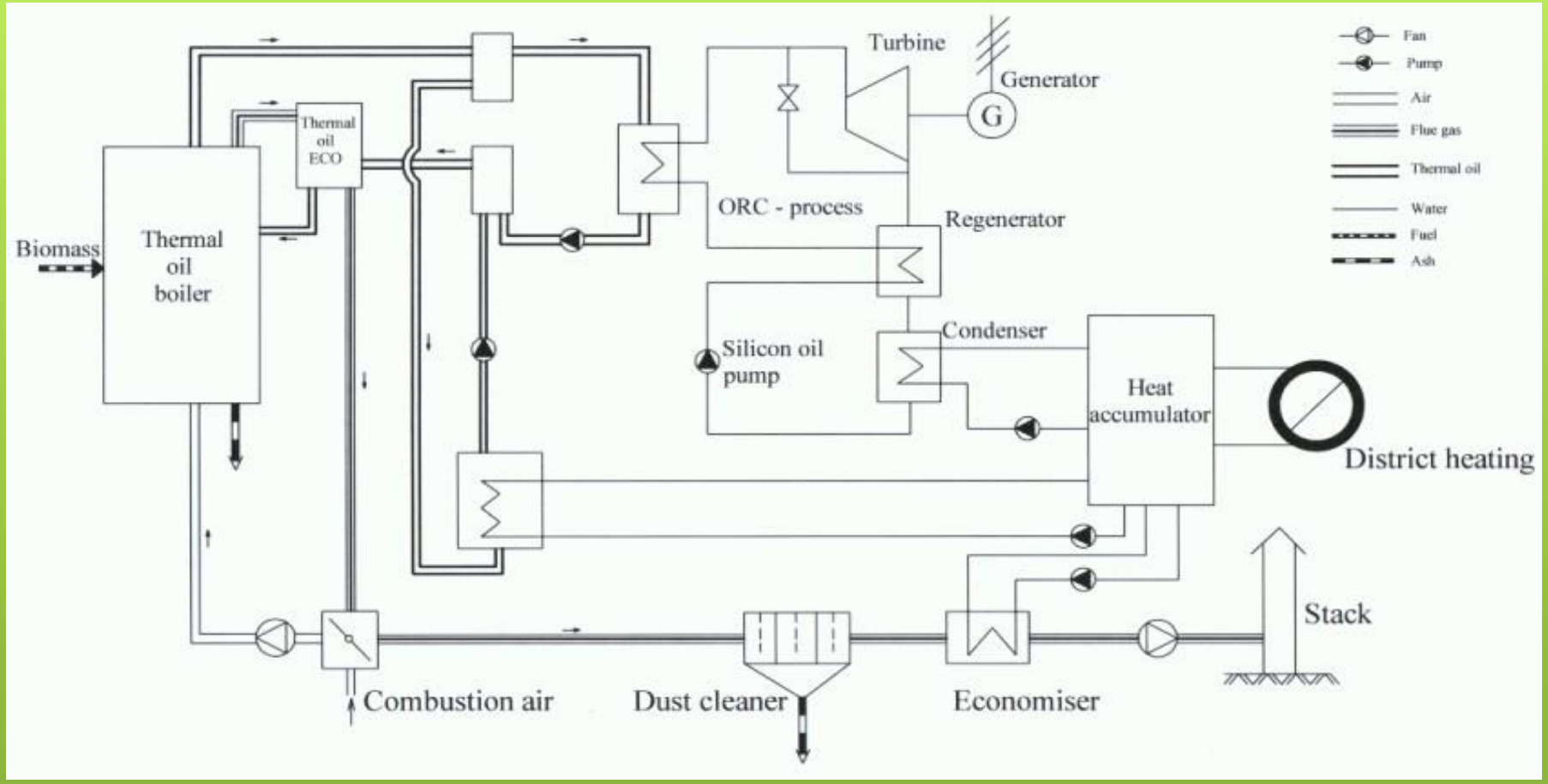




Advantages

- Minimal fuel preparation;
- Simple construction;
- Low investment cost;
- Low CO emission in flue gas;
- Low self consumption – 0,5%;

CHP facility



- **CHP (≈ 0.5-0.6 MW_e i ≈ 4-4.5 MW_{th}).**
- **Grant 6.818.000 € Suisse government.**
- **Project III42011**
- **HORIZON 2020**

Conclusions

1. A cigar type furnace has been developed, with some unique patented technical solutions.
2. Developed furnace specifically designed for baled agricultural residues.
3. R&D activities included all auxiliary equipment and logistic systems.
4. Suitable for CHP schemes up to 1-1,5 MW of electricity and 10 MW of heat.
5. Low cost technology, consistent with capabilities of local industry.
6. Solution suitable for WB and SEE countries.
7. Engagement of local industries, sustainable development of rural areas.