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# Active Condensation Hybrid Systems in Biomass Combustion

## AC-BC

### Program PRISMA

**Sub-program:** Engineering and technological sciences

**Participating Scientific and Research Organizations:**

Faculty of Mechanical and Civil Engineering in Kraljevo, University of Kragujevac, FMG

Faculty of Mechanical Engineering, University of Belgrade, FMEUB

Faculty of Technical Sciences in Čačak, University of Kragujevac, FTSC

**Principal Investigator:** Rade Karamarković, Ph.D. Mech. Eng., FMG

**Project duration:** January 2024-January 2027

The project aims to simultaneously utilize the higher heating value (**HHV**) of biomass and reduce particulate matter (**PM**) emissions from biomass boilers. In temperate climates, depending on environmental conditions, return water temperatures in central and district heating systems often exceed the dew point temperature of flue gas (**FG**). The active condensation (**AC**) concept, combining a condensation device and a heat pump (**HP**), harnesses the latent heat of **FG** at temperatures above its dew point. The project models and analyzes four systems designed to utilize waste heat from renewable sources: (i) **AC** with a quench and **HP**, (ii) **AC** with a flue gas condenser (**FGC**) and **HP**, which also functions as a heat pipe heat exchanger (**HEX**), (iii) **AC** with a natural gas-fired compressor **HP**, and (iv) biomass-fueled absorption **HP**. Systems (ii), (iii), and (iv) represent original solutions developed by the project team. In addition to their hybrid nature, these systems aim to reduce **PM** emissions. The project incorporates a quench (wet scrubber) and an **FGC** for emissions reduction in systems (i) and (ii), respectively. The quench will be optimized for water consumption, pressure drop, and **PM** separation. The **FGC** will be a shell and tube **HEX** equipped with turbulators to enhance heat transfer, clean surfaces, and reduce **PM** emissions.

The project's focus includes building and experimentally investigating systems (i) and (ii). It aims to contribute models, analyses, and conclusions to the scientific community regarding **AC** hybrid systems, quench and **FGC** designs, and practical experience to ensure the reliable and durable operation of these systems. Ultimately, the project seeks to promote sustainable and cost-effective implementations of these concepts to improve energy efficiency and reduce **PM** emissions in biomass boiler rooms.

**Total budget: 282,558.20 €**



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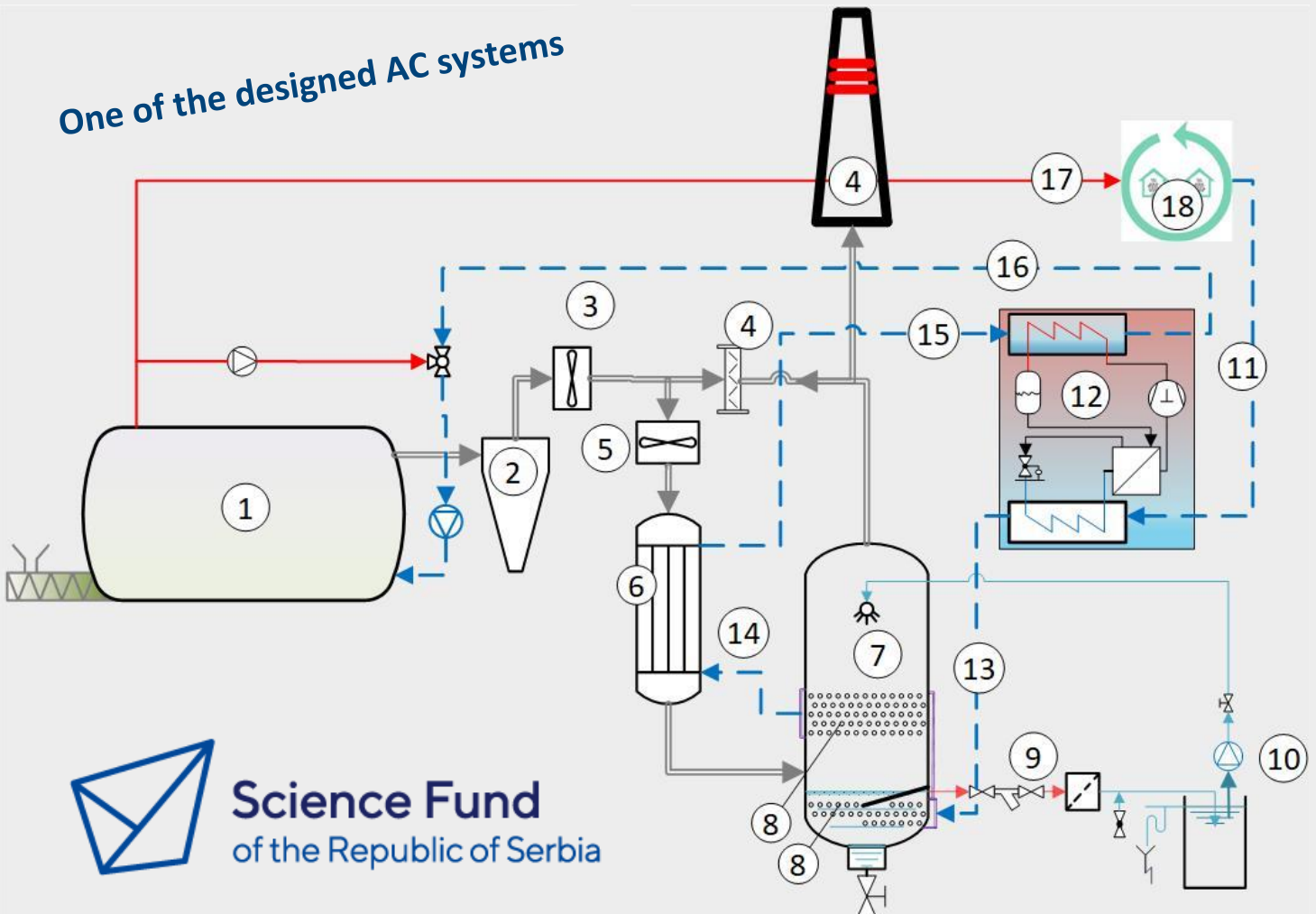
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### Members of the Project Team

ID	Name and family name	SRO	Person-months	Effective person-months
PI	Karamarković Rade	FMG	36	10.80
TM1	Todorović Dušan	FMEUB	36	10.80
TM2	Jovović Aleksandar	FMEUB	36	7.20
TM3	Radić Dejan	FMEUB	36	7.20
TM4	Obradović Marko	FMEUB	36	10.80
TM5	Radenković Darko	FMEUB	36	10.80
TM6	Nikolić Miloš	FMG	36	10.80
TM7	Marjanović Milan	FTSC	36	10.80
TM8	Novčić Đorđe	FMG	36	10.80
			<b>Total Person-months:324</b>	<b>Total Effective person-months: 90</b>

One of the designed AC systems



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