CU 9.10: ENERGY PRODUCTION

Director of studies: Yann ROGAUME

Hourly volume

In-person	*Self-directed study*
14 H Lectures	**50 H**
16 H Tutorials	
94 H Practicals	

General CU objectives:

Master the processes of energy recovery from wood and biomass through dry methods (combustion, pyrolysis, gasification). Know how to choose and advise adapted solutions taking into account technical, local, regulatory constraints, etc. Know the different fuels and choose the most suitable according to the context.

• Renewable energies (3.5 hours of classes + 4.00 hours of lectures and 16 hours of visits):
The different deposits and trends. The main characteristics of a fuel and each of those proposed with the impact of this on the results of energy production. Examples of plants and packaging lines.

• Biomass combustion– domestic (3.5 hours of classes + 4 hours of tutorials + 16 hours of practicals):
Sizing of different types of devices, regulations, environmental impact, pollutant reduction techniques, optimisation of settings, operating appraisals, choice of devices according to needs, etc.

• Biomass combustion– industries (3.5 hours of classes + 4 hours of tutorials +16 hours of practicals):
Project assembly stages: supply plan, fuel qualities, adaptation of the boiler as required, sizing of the main parts, types of installations, heating networks, cogeneration, adapted regulations, main actors, legal aspects, operation of boilers, environmental impact, etc.

• Pyrolysis and gasification of biomass (3.5h hours of classes + 4 hours of tutorials + 16 hours of practicals):
Material and energy balances of processes, impact of operating conditions, main industrial processes and reactors, uses and developments. Characteristics of the products obtained, energy and environmental optimisation of processes. Tests on laboratory reactors, product characterisation and assessment.

Consists of:

- Part 1: Biomass resources and preparation
- Part 2: Biomass combustion– domestic
- Part 3: Biomass combustion– industries
- Part 4: Pyrolysis and gasification of biomass

Positioning of the CU in the School reference system:

after semester 8

Updated on 31 March 2025

CU 9.10: ENERGY PRODUCTION

Part 1: Biomass resources and preparation	**Coefficient 1**
Session leaders: Outside session leaders	
Teaching assistants:	
Prerequisites: CU 7.2	
Teaching materials: Presentation slides– Reading list– Reference book– visits to specific sites (EGGER, NFB, FBE, BF70, Mougenot Sawmill, etc.)	
Assessment methods: individual Report – Bibliography	

Learning outcomes	**Description**	**Number of student hours (in-person)**		
		Lectures	**Tutorials**	**Practicals**
Know and describe the operation of the main types of biomass deposits, particularly wood. Select the appropriate resource type for a usage type. Evaluate the advantages and disadvantages of each solution.	The different types of deposits, main characteristics of fuels, advantages and disadvantages.	**3.50**		
	Forestry management and timber sales conferences (ONF, Forêts et Bois de l'Est).		**4.00**	
	Visit to a log production site.			**4.00**
	Visit to a wood pellet production site.			**4.00**
	Visit to a cogeneration site.			**4.00**
	Visit to a CSR waste sorting and packaging site.			**4.00**
		3.50	**4.00**	**16.00**

CU 9.10: ENERGY PRODUCTION

Part 2: Biomass combustion– domestic	**Coefficient 1**
Session leaders: Yann ROGAUME, PhD students	
Teaching assistants:	
Prerequisites: CU 7.2	
Teaching materials: Presentation slides– Reading list– Reference book	
Assessment methods: individual and in groups Class assignment– Report– Bibliography	

Learning outcomes	**Description**	**Number of student hours (in-person)**		
		Lectures	**Tutorials**	**Practicals**
Size household wood-burning appliances of all types. Know the standards and regulations related to the operation of domestic wood-burning appliances. Analyse the operation of wood-burning appliances. Organise tests to validate and optimise the operation of log and pellet appliances	Regulatory context for domestic wood heating and presentation of the main standards.	1.75		
	Size a wood-burning heater for different fuels.	1.75	2.00	
	Characterise fuels according to standardisation		2.00	
	Carry out combustion tests on an independent logging machine. Optimise the operation, analyse the results and edit a test report.			8.00
	Carry out combustion tests on a pellet boiler. Optimise the operation, analyse the results and edit a test report.			8.00
		3.50	**4.00**	**16.00**

Updated on 31 March 2025

CU 9.10: ENERGY PRODUCTION

Part 3: Biomass combustion– industries	**Coefficient 1**
Session leaders: Yann ROGAUME and Engineer	
Teaching assistants:	
Prerequisites: CU 7.2	
Teaching materials: Presentation slides– Reading list– Reference book- Visits	
Assessment methods: individual and in groups Class assignment– Report– Bibliography	

Learning outcomes	**Description**	**Number of student hours (in-person)**		
		Lectures	**Tutorials**	**Practicals**
Size a power generation facility for a manufacturer or a local authority. Set up a project with all the constituent elements, from upstream to downstream. Analyse the operation of the facilities and propose improvements.	Stages of assembly of a collective or industrial wood boiler project.	3.50		
	Legal, regulatory and economic aspects of a wood-fired boiler project.		4.00	
	Combustion tests on automatic boiler and optimisation of its operation.			4.00
	Assessment of the operation of a heating network, possible optimisations, etc.			8.00
	Visits to two industrial and collective wood boiler sites.			4.00
		3.50	**4.00**	**16.00**

CU 9.10: ENERGY PRODUCTION

Part 4: Pyrolysis and gasification of biomass	**Coefficient 1**
Session leaders: Yann ROGAUME, Pierre GIRODS, Mathieu DEBAL	
Teaching assistants:	
Prerequisites: CU 7.2	
Teaching materials: Presentation slides– Reading list– Reference book	
Assessment methods: individual and in groups Class assignment– Report– Bibliography	

Learning outcomes	**Description**	**Number of student hours (in-person)**		
		Lectures	**Tutorials**	**Practicals**
Classify the different reactors and processes according to the operating conditions. Analyse the operation of each type of reactor and process. Determine the right conditions to achieve desired results. Carry out material and energy balances on the processes.	Review of the main processes and their applications. Equations for appraisals and sizing calculations.	3.50	4.00	
	Study of thermal degradation of biomass– kinetic calculations.			8.00
	Pyrolysis study: gas monitoring, material appraisal.			4.00
	Study of gasification in pilot reactor.			4.00
		3.50	**4.00**	**16.00**

Updated on 31 March 2025