

IEA Bioenergy Agreement: 2013-2015

Task 33: Thermal Gasification of Biomass

(Ischia, 14.05.2014)

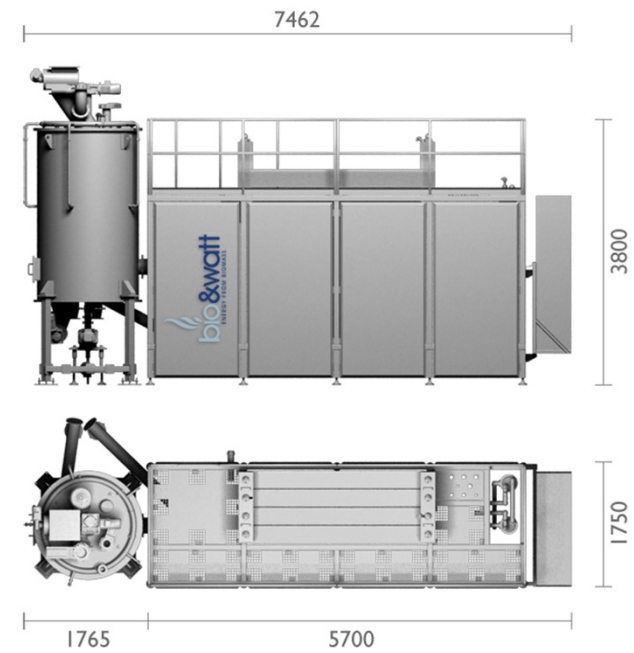
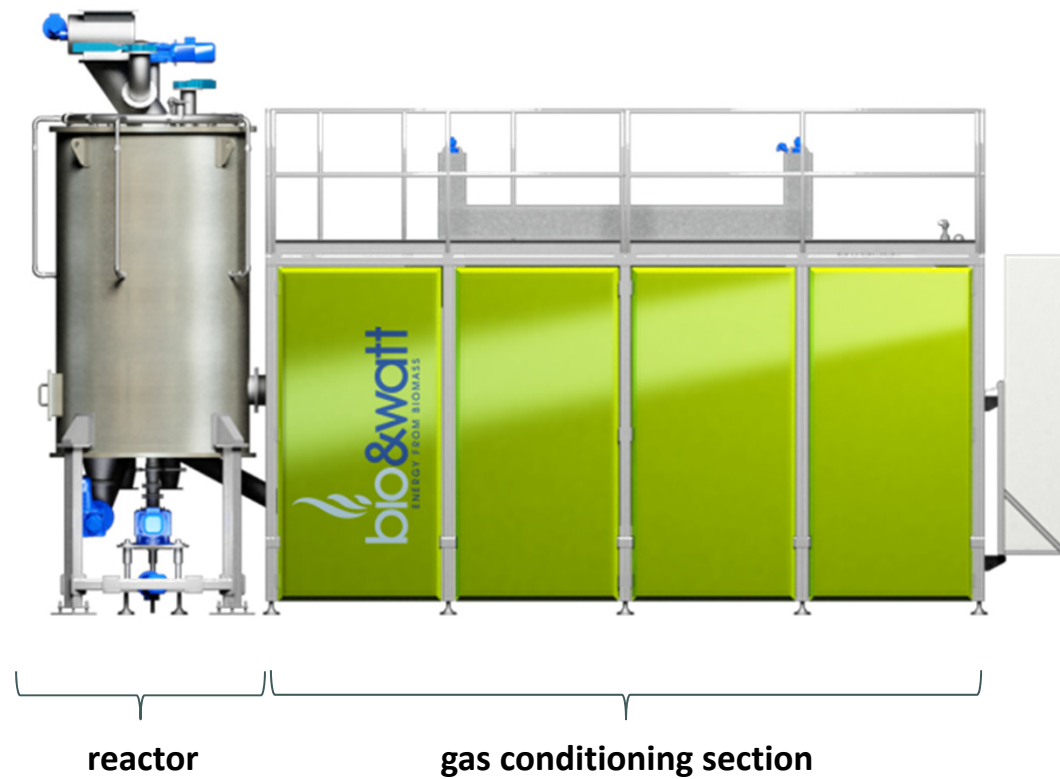
Marco Fantacci

**Energy conversion of biomass through pyro-gasification
process: presentation of an industrial solution**

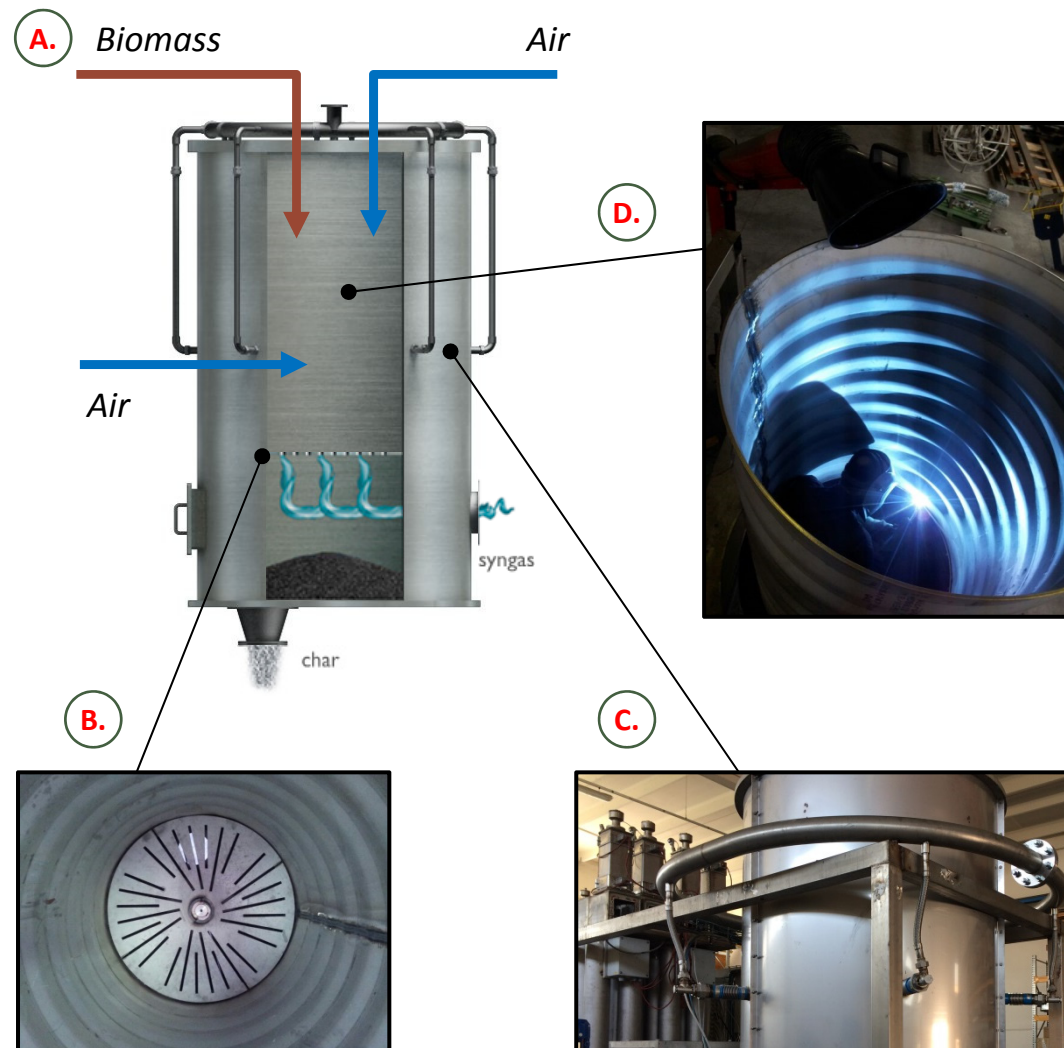
Bio&Watt gasification plant – key characteristics

- ➔ **Small Capacity:** 200÷300 kWel per single module
- ➔ **Compact design:** soil occupancy of the gasification module ca 14sqm / of the entire plant ca 400sqm
- ➔ **Easy maintenance** to achieve higher reliability
- ➔ **Closed cycle:** no waste products (but the ash originally contained in the biomass fed to the plant), all the energy potential of the biomass is exploited
- ➔ **Broad range of applicable fuels** (biomass pre-treatment needed)

The core: gasification reactor + gas conditioning section



The gasification reactor



Reactor technology in a nutshell

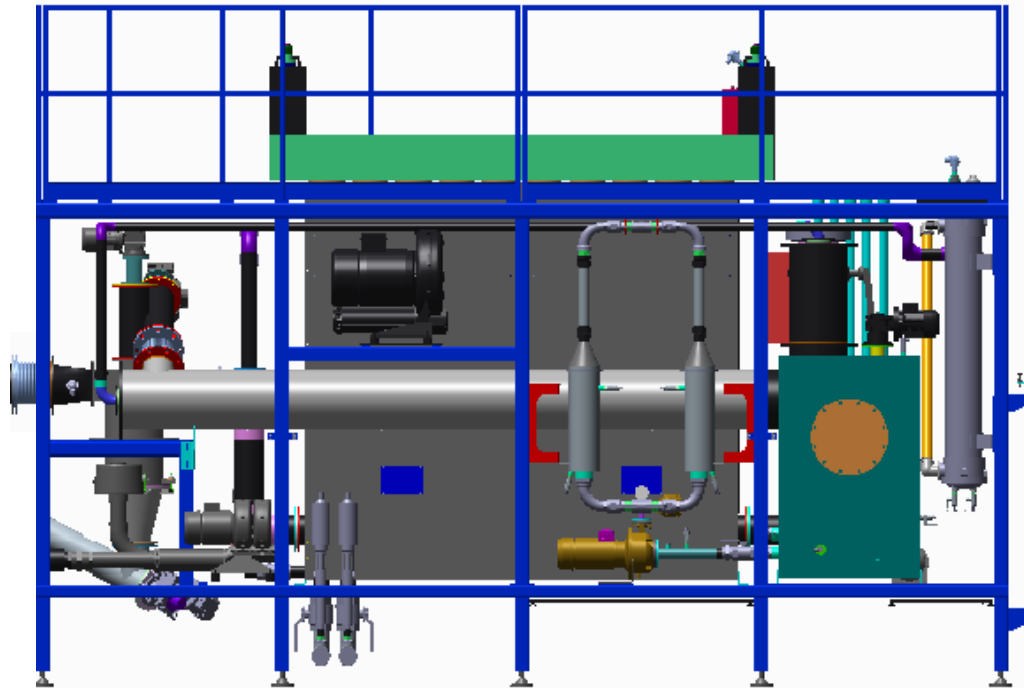
- A. downdraft**
- B. fixed bed/ stratified**
- C. double fire**
- D. no refractory**

Focus on:

- design simplicity
- easy maintenance
- energy conversion
- low TAR production

European patent granting procedure pending.

The producer gas conditioning section



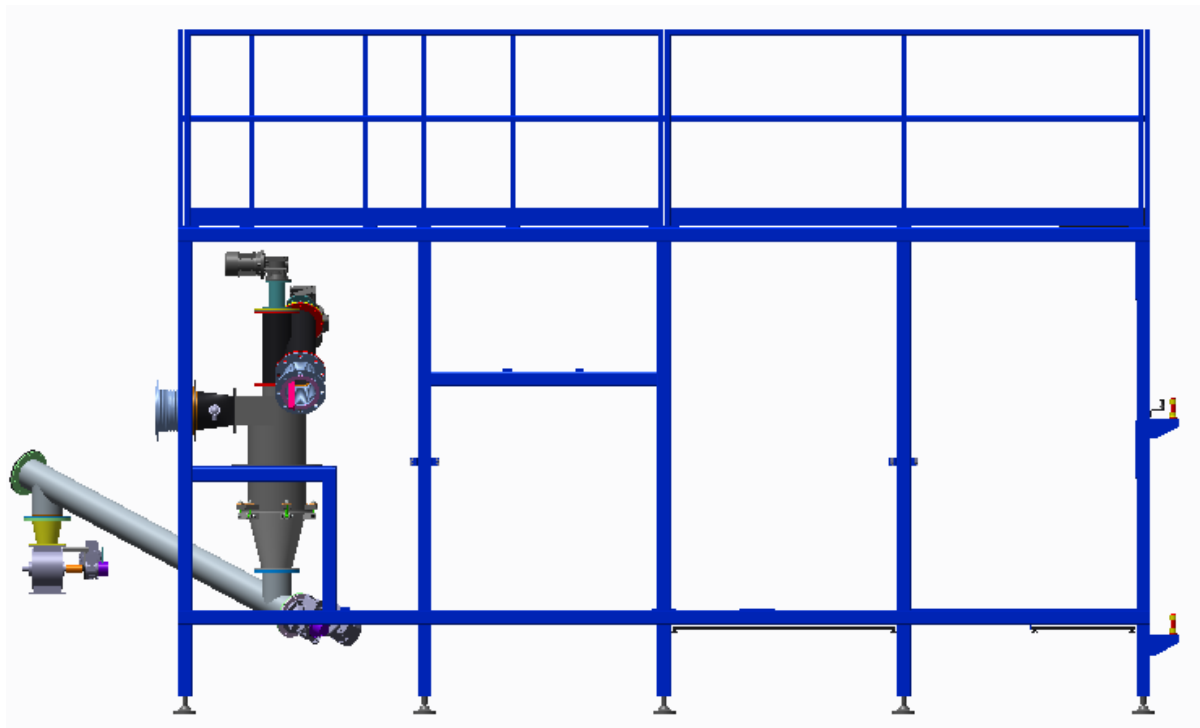
Syngas conditioning chain

- A. Cyclone separator
- B. Wet scrubber
- C. Electrostatic precipitator

Focus on:

- fouling prevention
- syngas de-dusting
- syngas cooling (from 700°C to <40°C)
- TAR separation
- NO mechanical filtration

The producer gas conditioning section



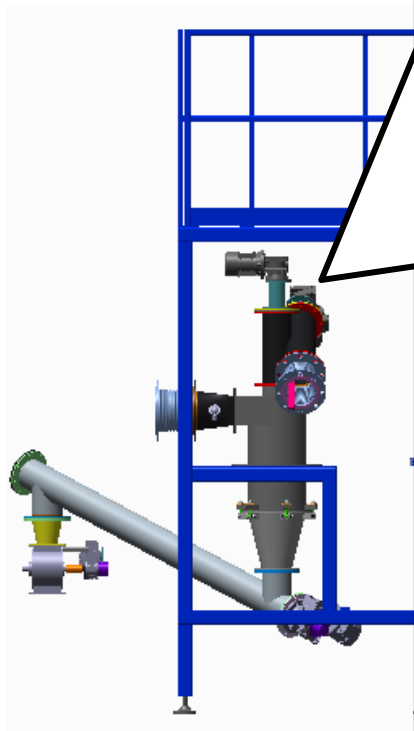
Syngas conditioning chain

- A. Cyclone separator
- B. Wet scrubber
- C. Electrostatic precipitator

Focus on:

- **fouling prevention**
- **syngas de-dusting**
- syngas cooling (from 700°C to <40°C)
- TAR separation
- NO mechanical filtration

The producer gas conditioning section



mechanical anti-fouling in any hot gas pipe

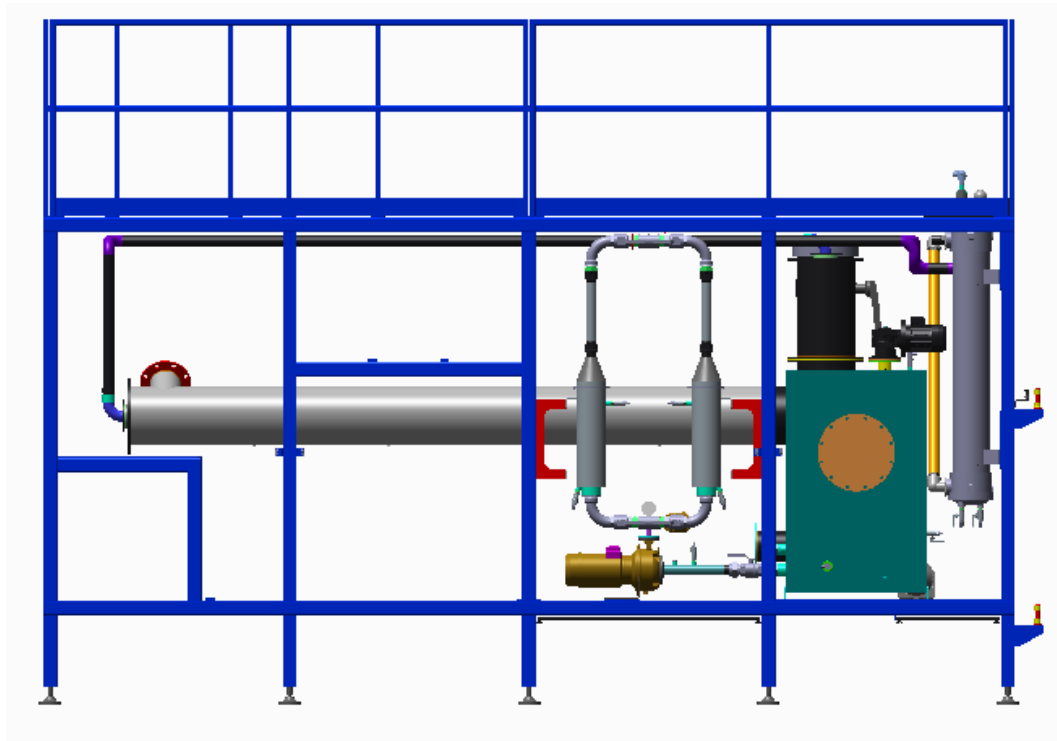
Syngas conditioning chain

- A. Cyclone separator
- B. Wet scrubber
- C. Electrostatic precipitator

Focus on:

- **fouling prevention**
- **syngas de-dusting**
- syngas cooling (from 700°C to <40°C)
- TAR separation
- NO mechanical filtration

The producer gas conditioning section



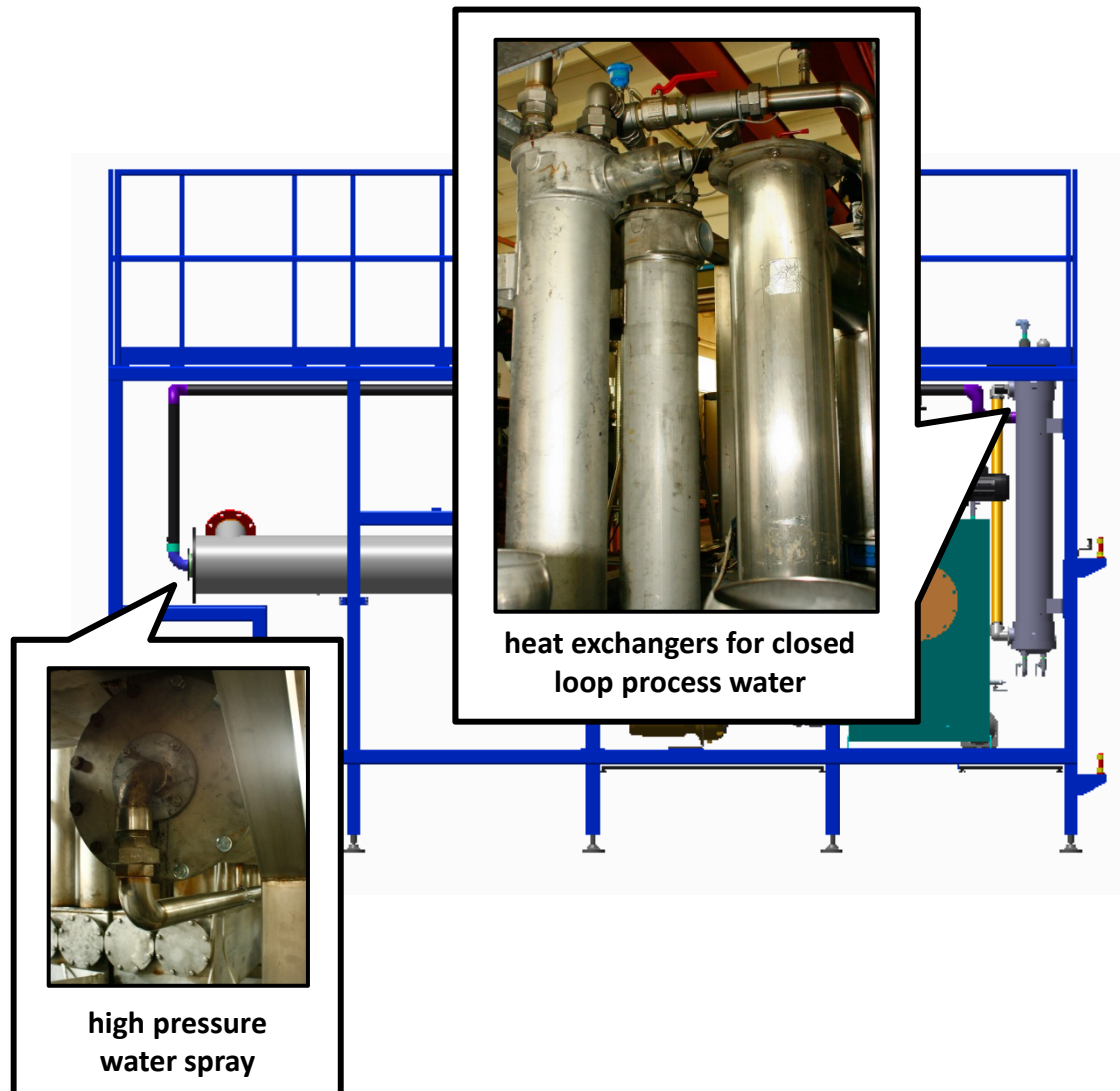
Syngas conditioning chain

- A. Cyclone separator
- B. Wet scrubber**
- C. Electrostatic precipitator

Focus on:

- fouling prevention
- syngas de-dusting
- **syngas cooling (from 700°C to <40°C)**
- **TAR separation**
- NO mechanical filtration

The producer gas conditioning section



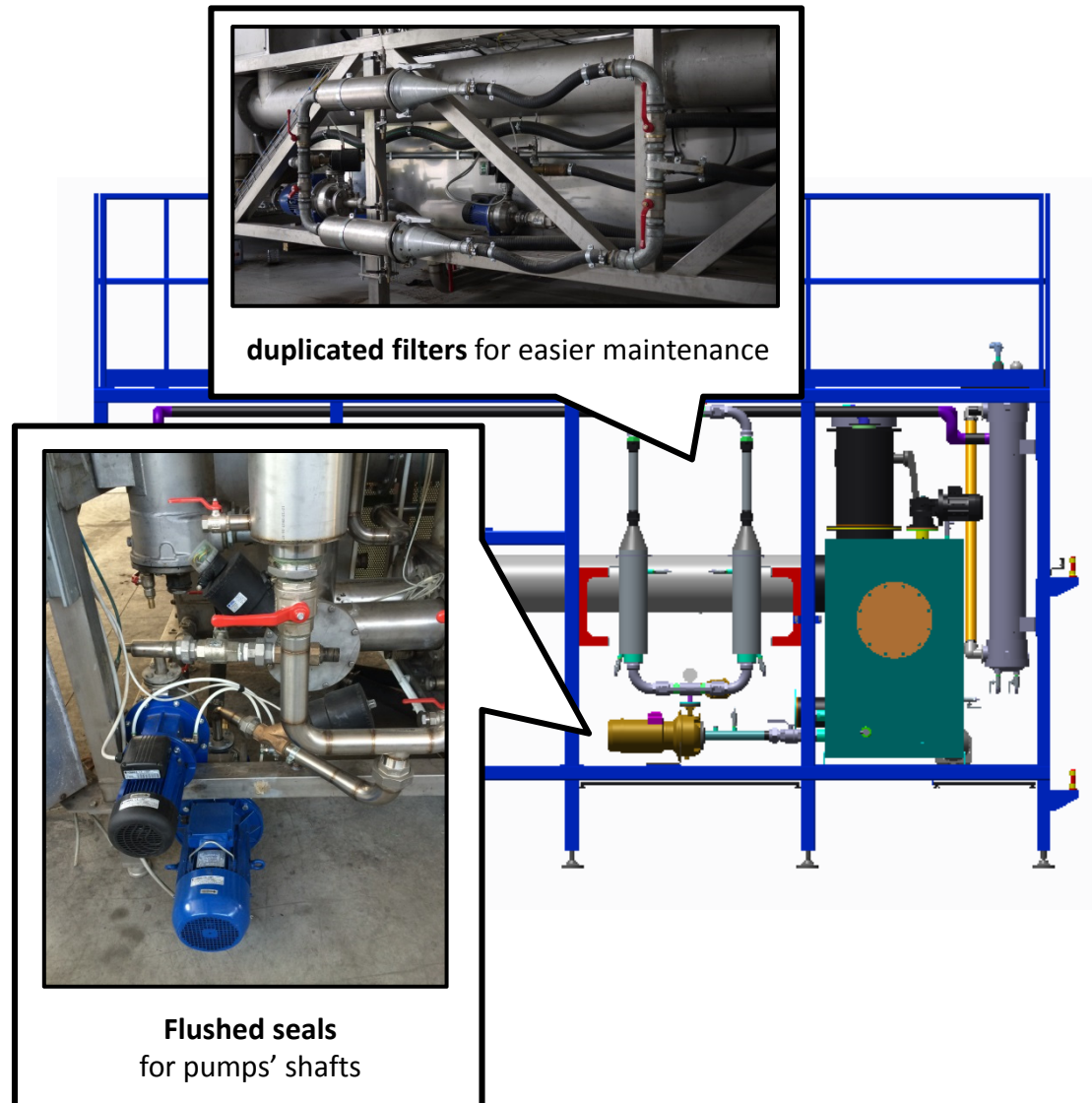
Syngas conditioning chain

- A. Cyclone separator
- B. Wet scrubber**
- C. Electrostatic precipitator

Focus on:

- fouling prevention
- syngas de-dusting
- **syngas cooling (from 700°C to <40°C)**
- **TAR separation**
- NO mechanical filtration

The producer gas conditioning section



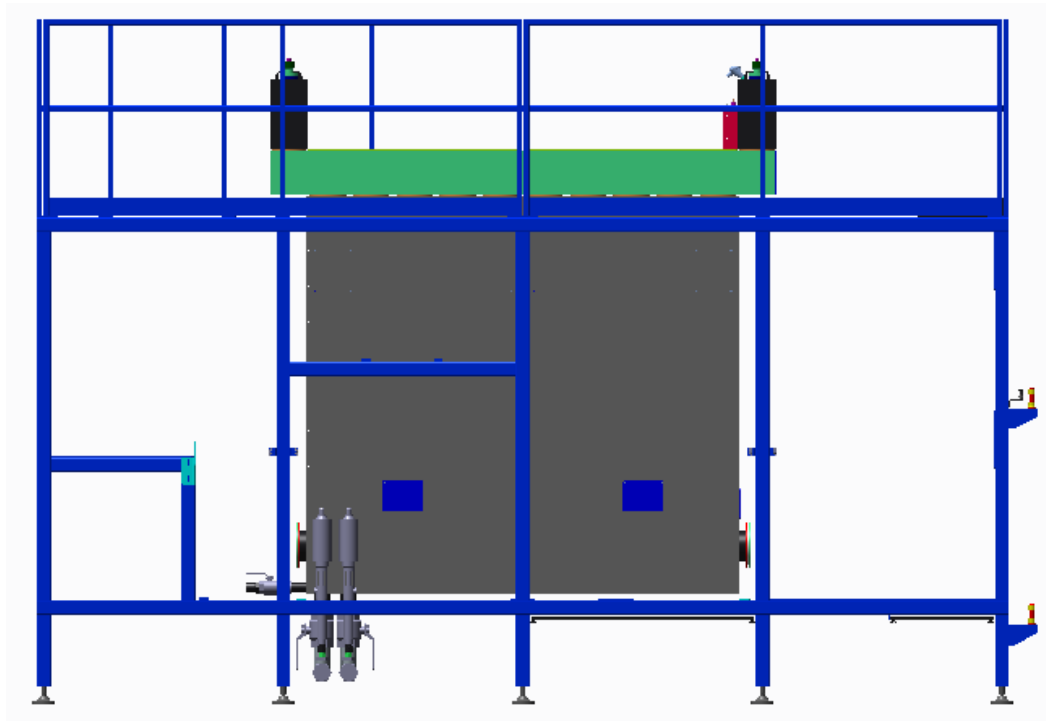
Syngas conditioning chain

- A. Cyclone separator
- B. Wet scrubber**
- C. Electrostatic precipitator

Focus on:

- fouling prevention
- syngas de-dusting
- **syngas cooling (from 700°C to <40°C)**
- **TAR separation**
- NO mechanical filtration

The producer gas conditioning section



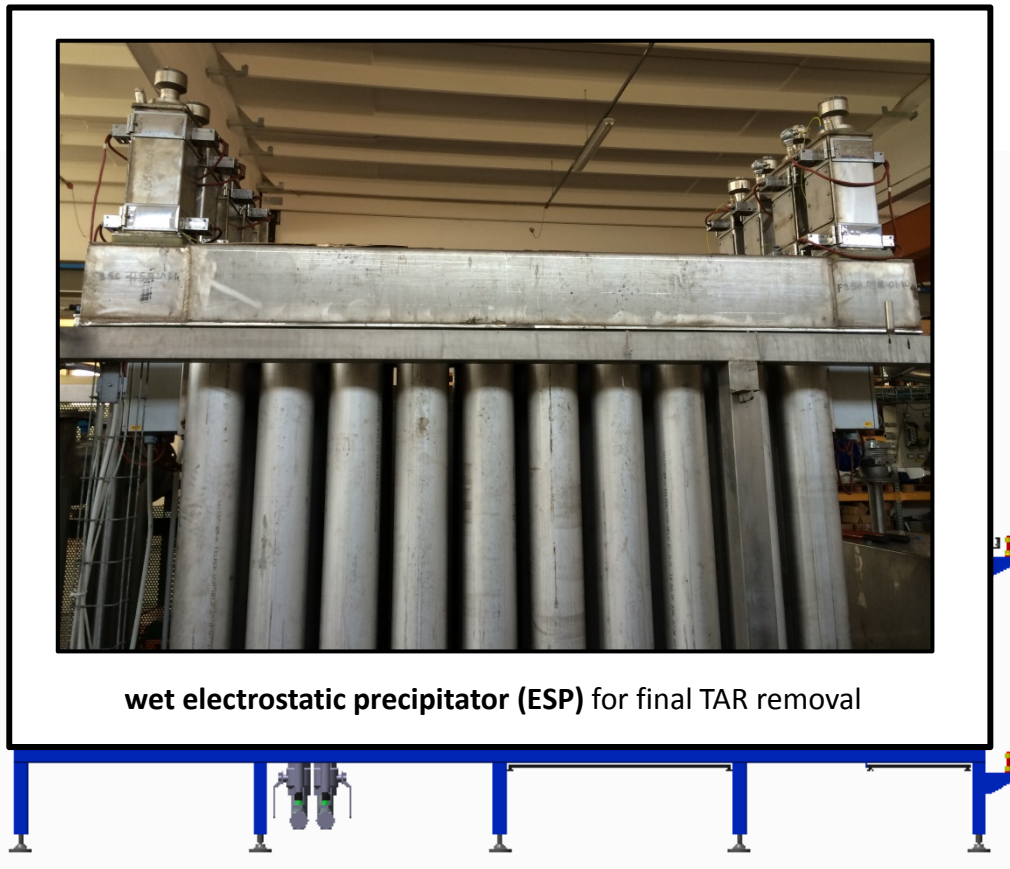
Syngas conditioning chain

- A. Cyclone separator
- B. Wet scrubber
- C. **Electrostatic precipitator**

Focus on:

- fouling prevention
- syngas de-dusting
- syngas cooling (from 700°C to <40°C)
- **TAR separation**
- **NO mechanical filtration**

The producer gas conditioning section



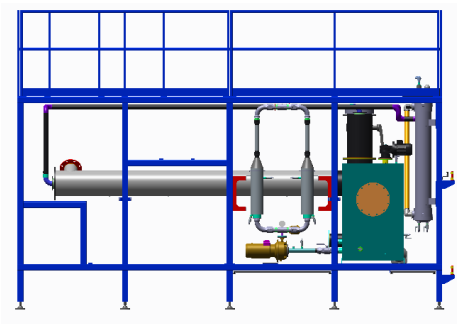
Syngas conditioning chain

- A. Cyclone separator
- B. Wet scrubber
- C. Electrostatic precipitator**

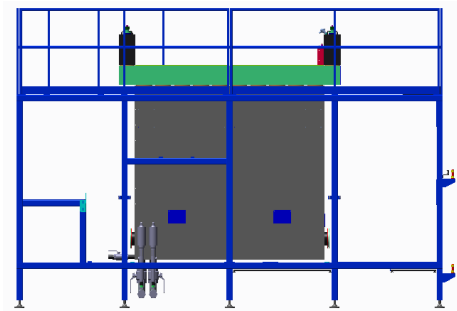
Focus on:

- fouling prevention
- syngas de-dusting
- syngas cooling (from 700°C to <40°C)
- **TAR separation**
- **NO mechanical filtration**

The producer gas conditioning section



wet scrubber



wet ESP



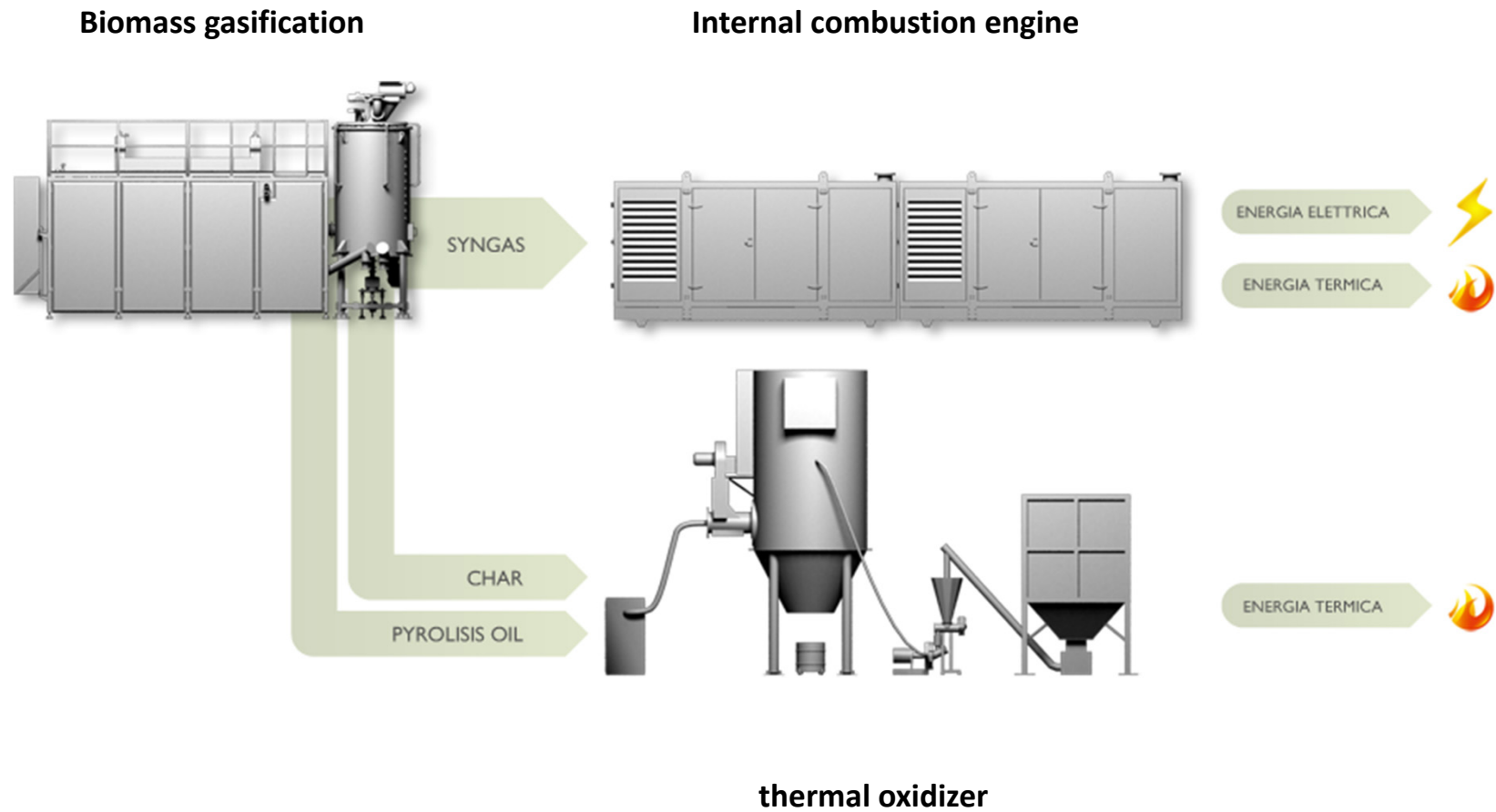
TAR separation

Process water from wet scrubber and wet ESP is sent to a **specifically designed settling tank** in order to separate TAR

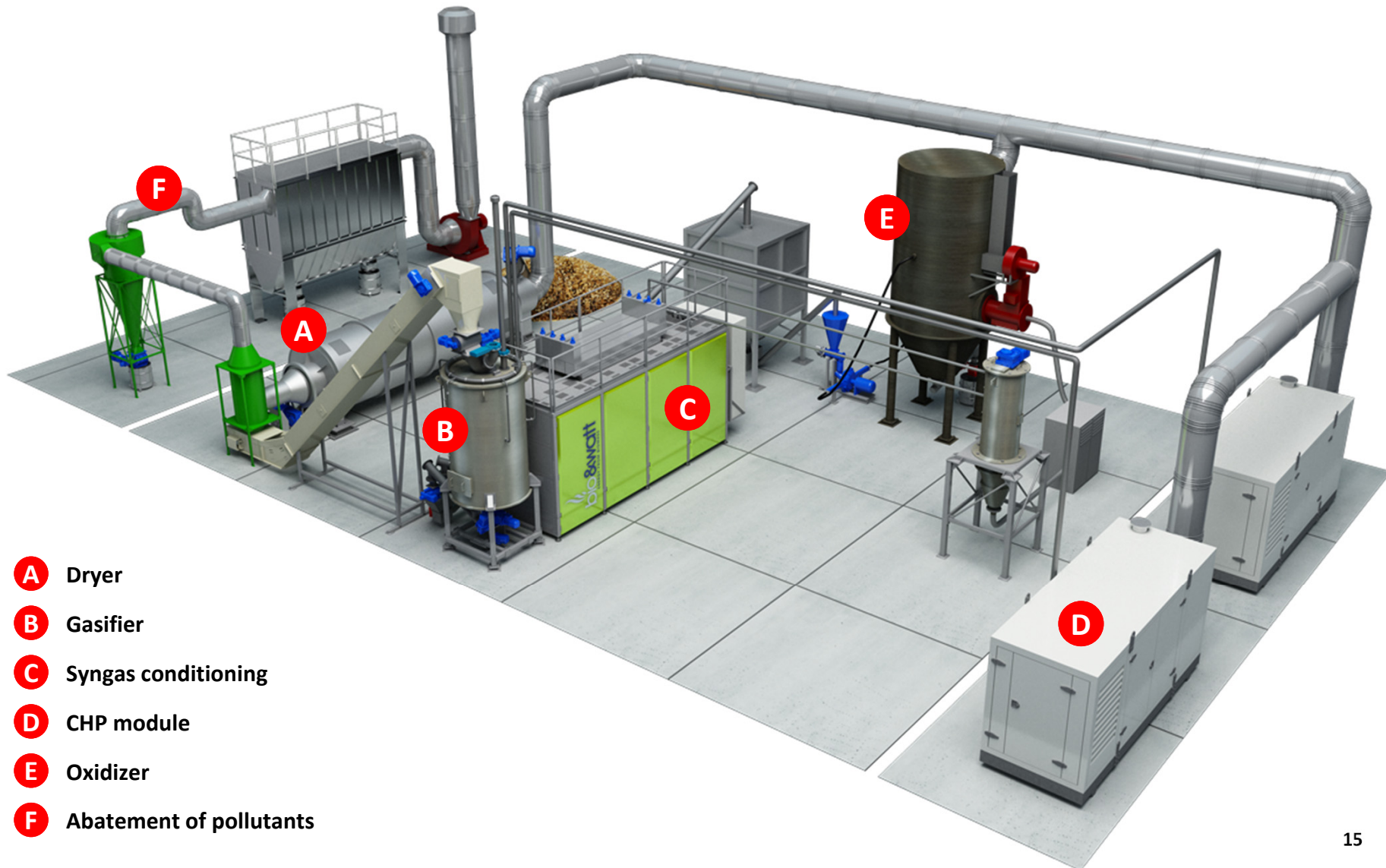
Focus on:

- complete TAR separation from process water
- reuse of water in a closed-loop cycle
- automated management: custom built water-TAR interface sensor

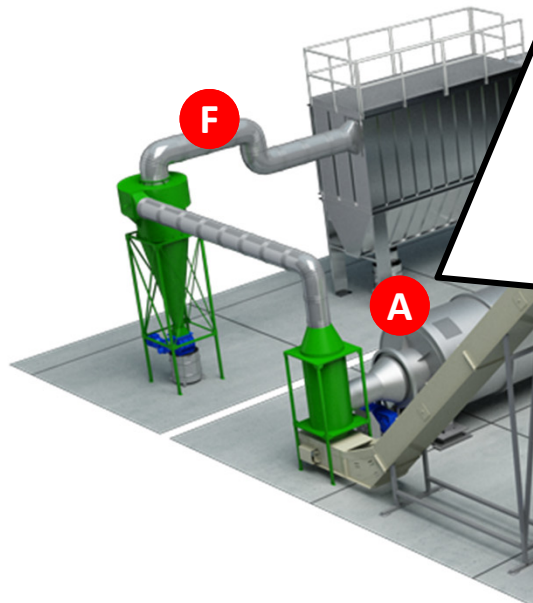
Energy conversion – from biomass to Power and Heat



Plant layout & main subsystems



Plant layout & main subsystems

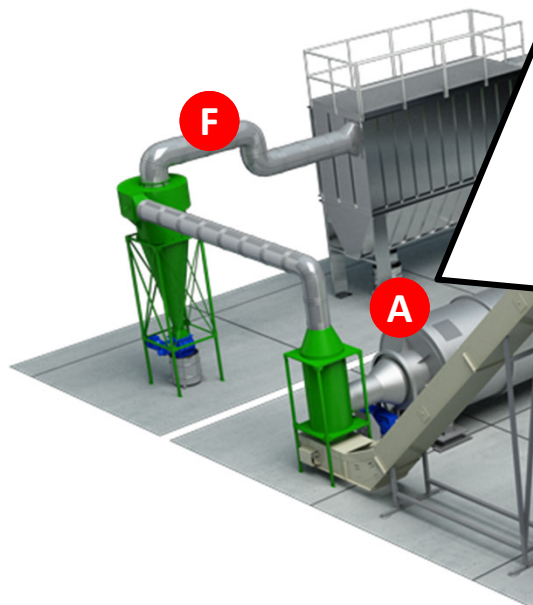


- A** Dryer
- B** Gasifier
- C** Syngas conditioning
- D** CHP module
- E** Oxidizer
- F** Abatement of pollutants



belt dryer (low temperature)

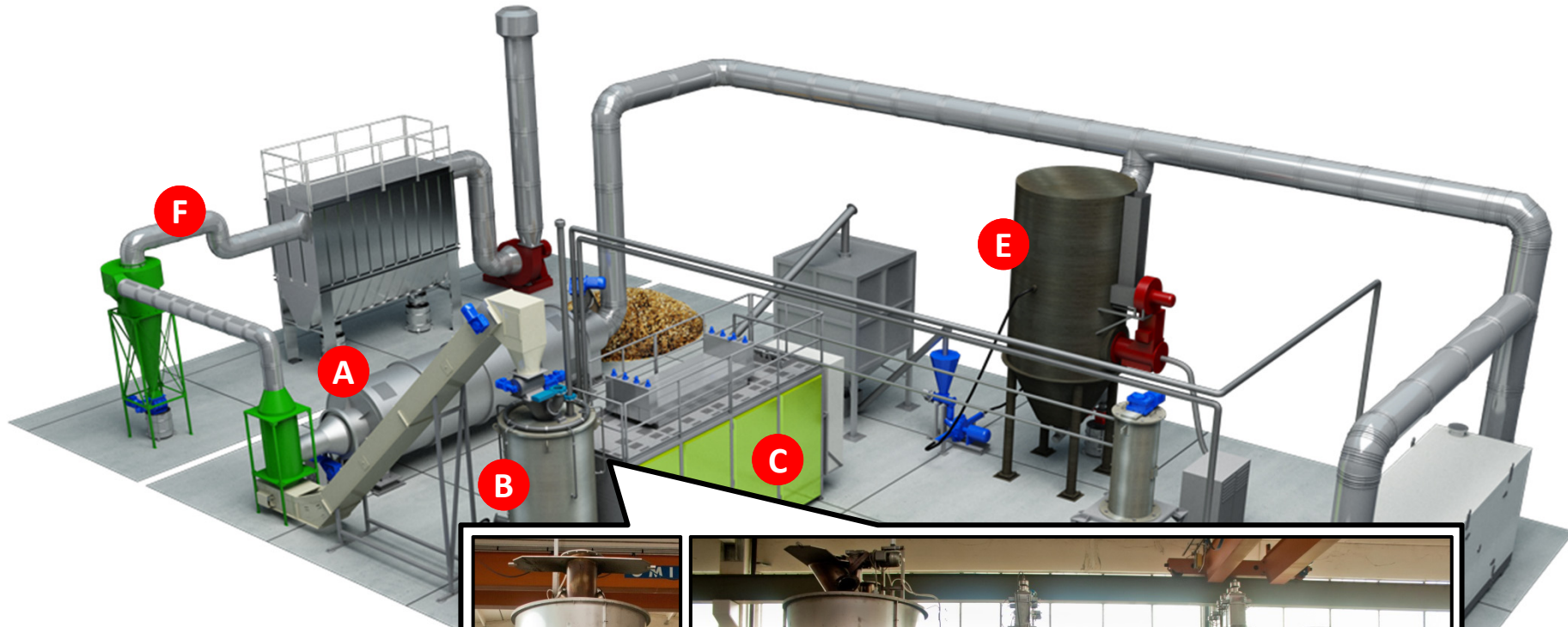
Plant layout & main subsystems



- A** Dryer
- B** Gasifier
- C** Syngas conditioning
- D** CHP module
- E** Oxidizer
- F** Abatement of pollutants



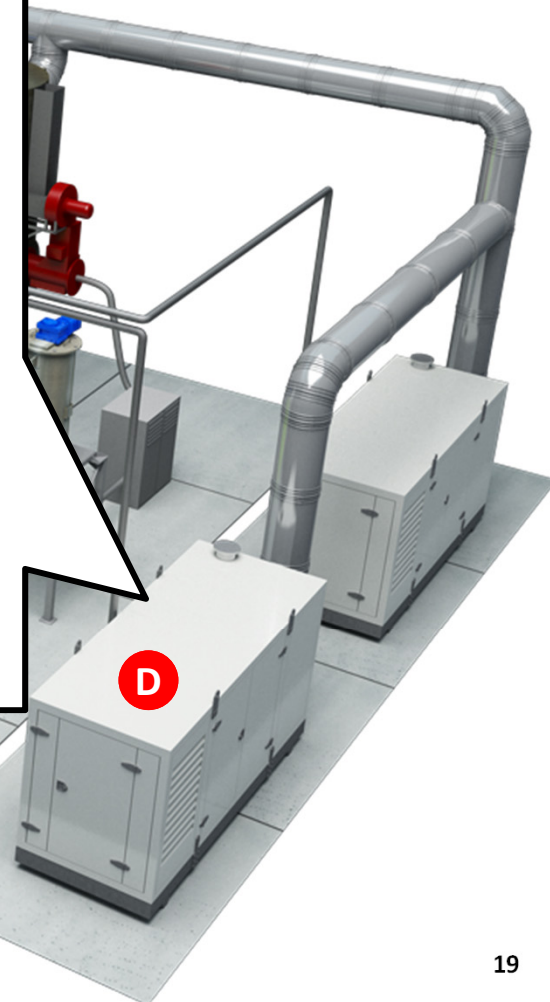
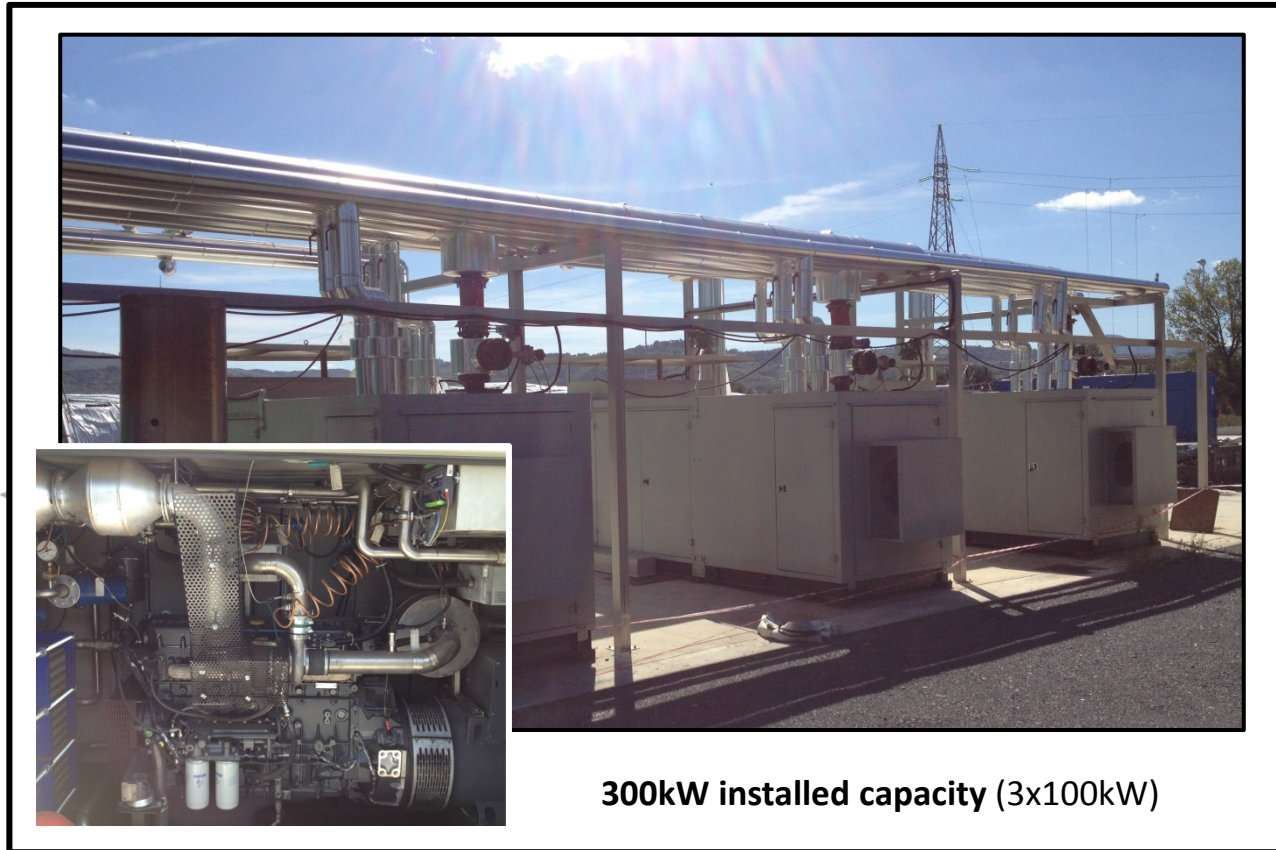
Plant layout & main subsystems



- A** Dryer
- B** Gasifier
- C** Syngas conditioning
- D** CHP module
- E** Oxidizer
- F** Abatement of pollutants

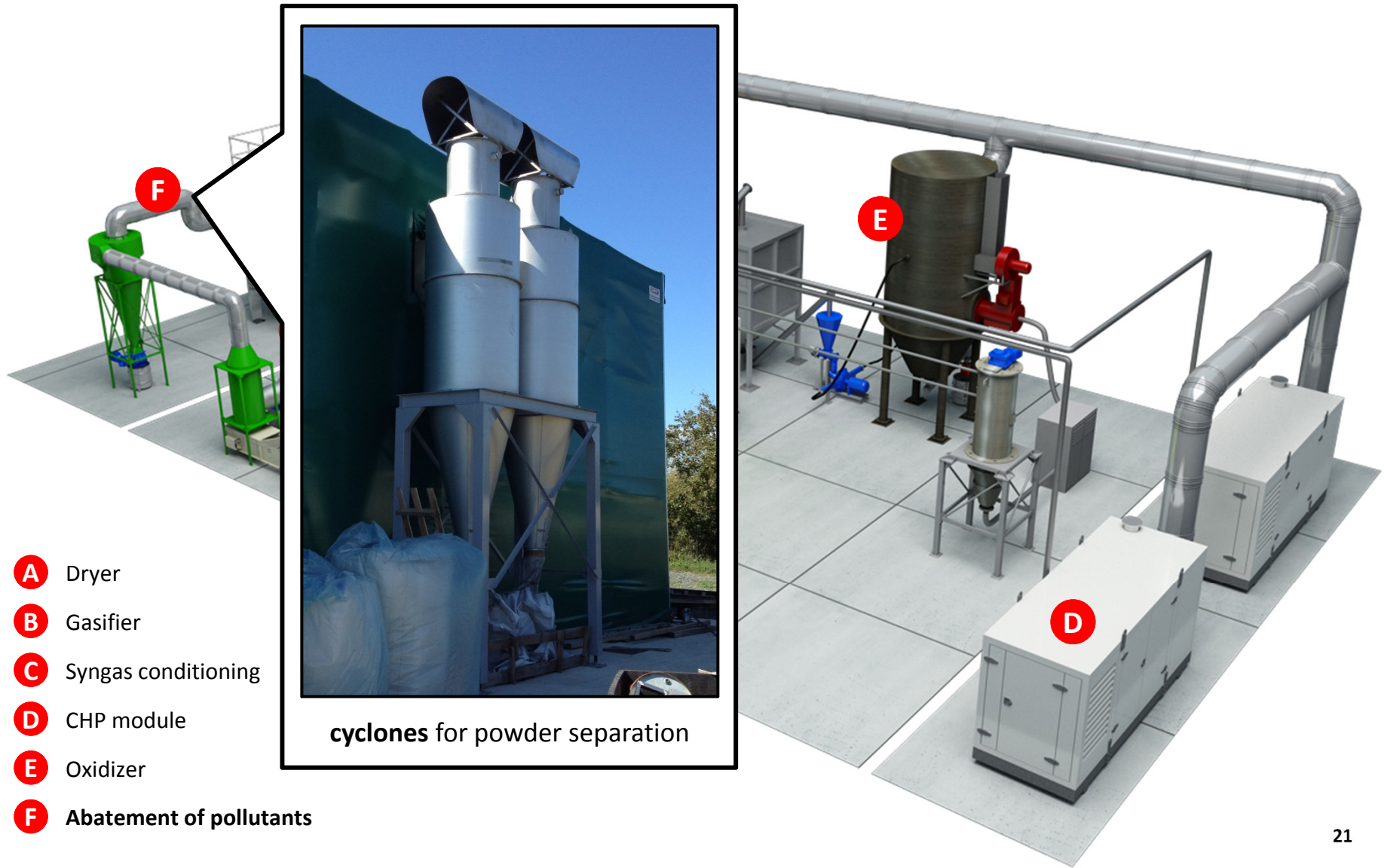


Plant layout & main subsystems



- C** Syngas conditioning
- D** CHP module
- E** Oxidizer
- F** Abatement of pollutants

Plant layout & main subsystems



Under development

