IEA Bioenergy

Biomass Gasification for Energy Purposes & Chemicals

Country Report – Italy

Birmingham – 25 November 2019

Donatella Barisano

ENEA -ITALY

Contents

- EU R&D Project
- National R&D Project
- Country Report – Italy
  - Italian context and technology spreading;
  - R&D Institutes;
  - Italian SMEs & Market;
  - R&D by SMEs

EU projects on Gasification involving Italy: Updates

Name	Funding	Aim	Reactor design	Present Status	Partners	link
BLAZE	H2020	Developing an advanced zero-emission **CHP** technology in the capacity range from small (25-100 kWe) to medium (0.1-5 MWe) by using low-cost and short-chain biomass feedstocks.	Bubbling fluidized bed	From 2019-03-01 to 2022-02-28, ongoing	**USGM**, UNIVAQ, ENEA, EPFL, Walter Tosto, SOLIDpower, HyGear, VERTECH GROUP, EUBIA	http://www.blazeproject.eu/
WASTE2GRIDS	H2020	Identify the most promising industrial pathways of waste gasification and solid-oxide cell (SOC) integrated **power**-balancing plants (W2G plants in short).	All types of reactors	From 2019-01-01 to 2020-06-30, ongoing	**EPFL**, ENEA, DTU, SOLIDpower SA	https://www.waste2grids-project.net/
CLARA	H2020	Chemical Looping gAsification foR sustainAble production of **biofuels.**	Dual fluidized bed reactors	From 2018-11-01 to 2022-10-31, ongoing	**EST**, REPOTEC, CHALMERS, UNIVAQ et al.; 13 partners	https://clara-h2020.eu/
LIG2LIQ	RFCS	Economically efficient production of **liquid fuels**, such as FT fuels or methanol, from lignite and SRF from municipal waste.	HT-Winkler reactor	From 2018-08-01 to 2022-01-31, ongoing	**TUDA**, UNIVAQ, ULSTER, CERTH, ICHPW, RWE, TKIS	https://www.lig2liq.eu/
Heat-To-Fuel	H2020	Biorefinery combining HTL and FT to convert wet and solid organic, industrial wastes into **2nd gen. biofuels** with highest efficiency	Dual circulating fluidized bed	From 2017-09-01 to 2021-08-31, ongoing	**GUSSING Energy Technologies**, RE-CORD, TUV, BIOENERGY 2020+, PoliTO, CRF et al.; 14 partners	http://www.heattofuel.eu/
BECOOL	H2020	Brazil-EU Cooperation for Development of **Advanced Lignocellulosic Biofuels** (twinned with the Brazilian BioVALUE project)	Indirect Circulating Fluidized Bed	From 2017-06-01 to 2021-05-31, ongoing	**UniBO**, BIOCHEMTEX SPA, CREA, RE-CORD, BTG, ECN et al.; 13 partners	https://www.becoolproject.eu/
COMSYN	H2020	Developing a new **BTL production** concept that will reduce biofuel production cost up to 35 % compared to alternative routes.	Dual fluidized bed gasifier	From 2017-05-01 to 2021-04-30, ongoing	**VTT Oy**, AMEC FW ITALIANA SRL, GKN, DLR, UniCRE, ÅF-Consult, INERATEC.	https://www.comsynproject.eu/
BRISK II	H2020	**Biofuels Research Infrastructure** for Sharing Knowledge II	Fluidized and Fixed Beds	From 2017-05-01 to 2022-04-30, ongoing	**KTH,** BIOENERGY 2020+ GMBH, ECN, KIT, ENEA et al.; 15 partners	https://www.brisk2.eu/
AMBITION	H2020	**Advanced biofuel** production with energy system integration	Fluidized and Fixed Beds	From 2016-12-01 to 2019-11-30, ongoing	**SINTEF**, ECN, DTU, ENEA, KIT et al. 8 partners	http://www.ambition-research.eu/
FLEDGED	H2020	FLExible **Dimethyl ether** (DME) production from biomass Gasification with sorption-enhanced processes	Dual circulating fluidized bed	From 2016-11-01 to 2020-10-31, ongoing	**PoliMI**, ECN, CSIC, LUT et al. 9 partners	http://www.fledged.eu/
3EMOTION	7 FP	**Hydrogen** production by parallel operation of electrolysers and biomass gasifier	Bubbling Fluidized Bed	From 2015-01-01 to 2019-12-31, ongoing	**VAN HOOL N.V.**, Uni LaSapienza, UnivAQ, ENEA et al.; 22 partners	http://www.3emotion.eu/

NB: This table is based on data available from the EU CORDIS database and project websites.

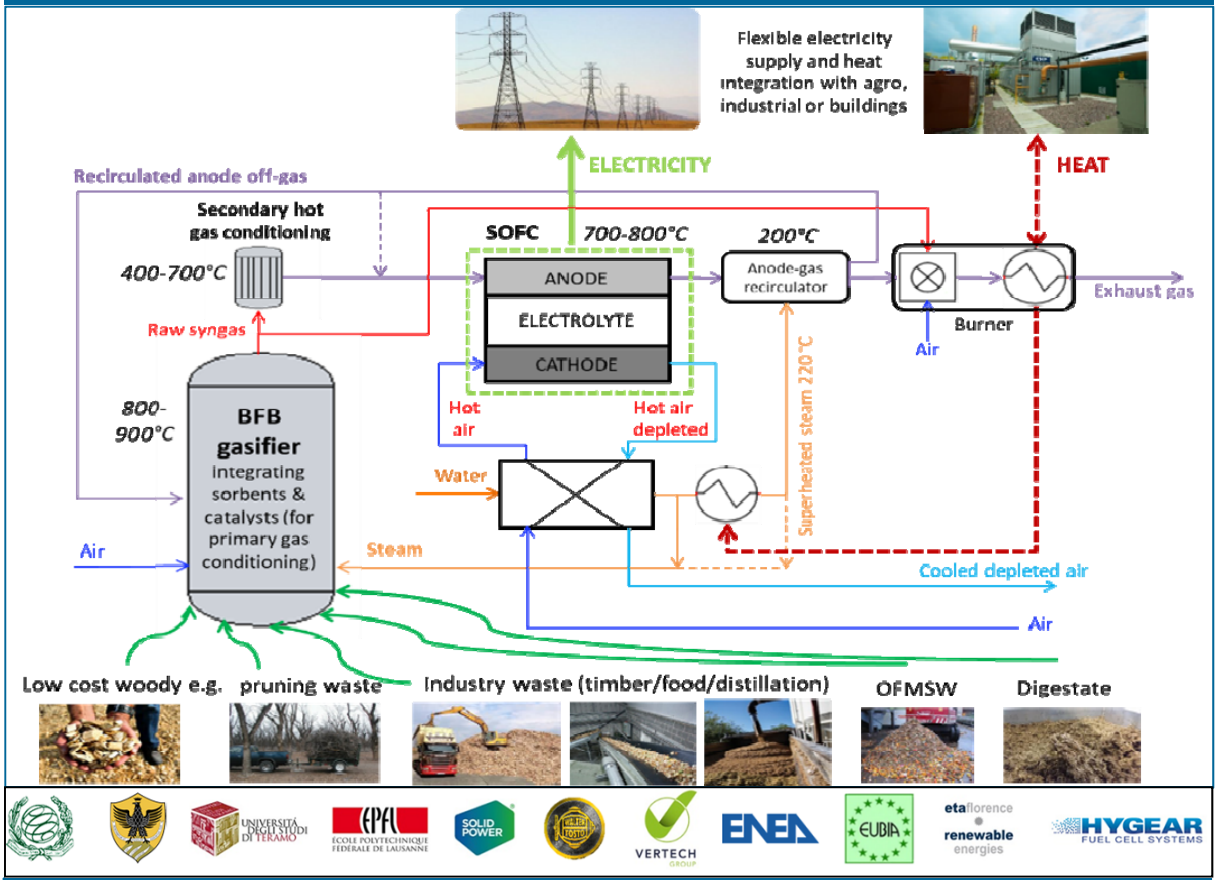
Projects on Gasification funded by National Programmes: Updates

Italian Region	Name	Funding	Aim	Reactor design	Present Status	Note
Basilicata & Calabria	WW-GREEN FUEL	MISE	Development of gasification process (dry and SCWG) for the exploitation of large-scale biomass and production of liquefied **SNG**.	Pyro-gasifier	Next start	**ENEA**, CNR, UNICAL, UNIBA, POLITO, SOTACARBO, CALABRA Maceri, et al.
Basilicata, Campania, Apulia, Sardinia, Lazio	COMETA	MISE	Use of residual biomass for **CHP** and **biofuels** production.	Downdraft & BFB	In progress	**Novamont**, ENEA, CREA, Uni Sassari, CIHEAM-Bari, BIOAGRITEST S.r.l, et al.
Basilicata	PIBE	Regional	**Infrastructure** and R&D activities aimed at producing biofuels, innovative biolubricants, biomethane and **syngas** for frontier energy applications.	Different types	Next Start	**ENEA**, CNR, UNIBAS
Basilicata	RETENERGY	Regional	Network of Lucanian's energy technology **infrastructures**.	Different types	Next start	**ENEA**, CNR, UNIBAS
Abruzzo & Lazio	HBF 2.0	MISE	Realizing a small scale **CHP** system (25 kWe, 55 kWth)	Bubbling Fluidized Bed	From Dec. 2016 To Nov. 2019 (+ 1y exten.)	**Walter Tosto SpA** (Large Enterp.), UnivAQ, Enertecna S.r.l., UniTuscia, Nuova Ma-Tec 2001 s.r.l.
Sardinia	Sotacarbo	MISE/Regional	Cogasification to efficient **power** production with CCS	Updraft Fixed Bed	In progress	http://www.sotacarbo.it/en/

The BLAZE Project

Horizon 2020
European Union Funding
for Research & Innovation

Biomass Low cost Advanced Zero Emission
small-to-medium scale integrated gasifier fuel cell
combined heat and power plant



H2020 RIA, 4 M€, 3/2019-2/2022, GA 815284
Project Coordinator: Prof. E. Bocci (USGM, Italy)

IEA Bioenergy

www.ieabioenergy.com

http://www.blazeproject.eu/

Aim of the project

BLAZE aims at developing Low cost, Advanced and Zero Emission first-of-a-kind small-to-medium Biomass CHP.

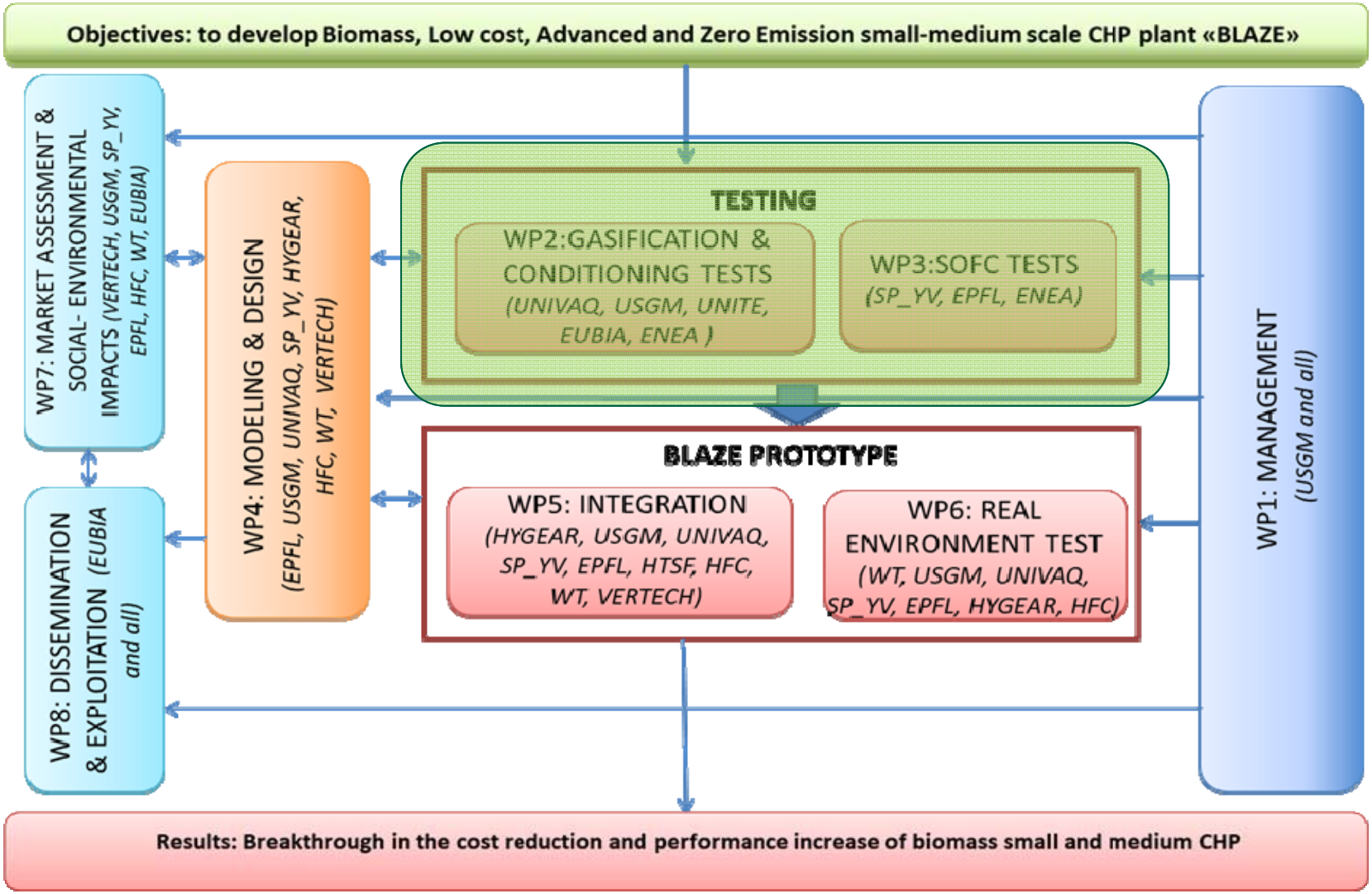
This aim is reached by:

- developing bubbling fluidised bed technology;
- integrating high temperature cleaning & conditioning system (syngas with zero particulate matter and ultra-low tar and contaminants content);
- integrating high temperature gas cleaning for HCl and H_2S removal;
- innovative key component for thermal and chemical integration of SOFC;

Target performances:

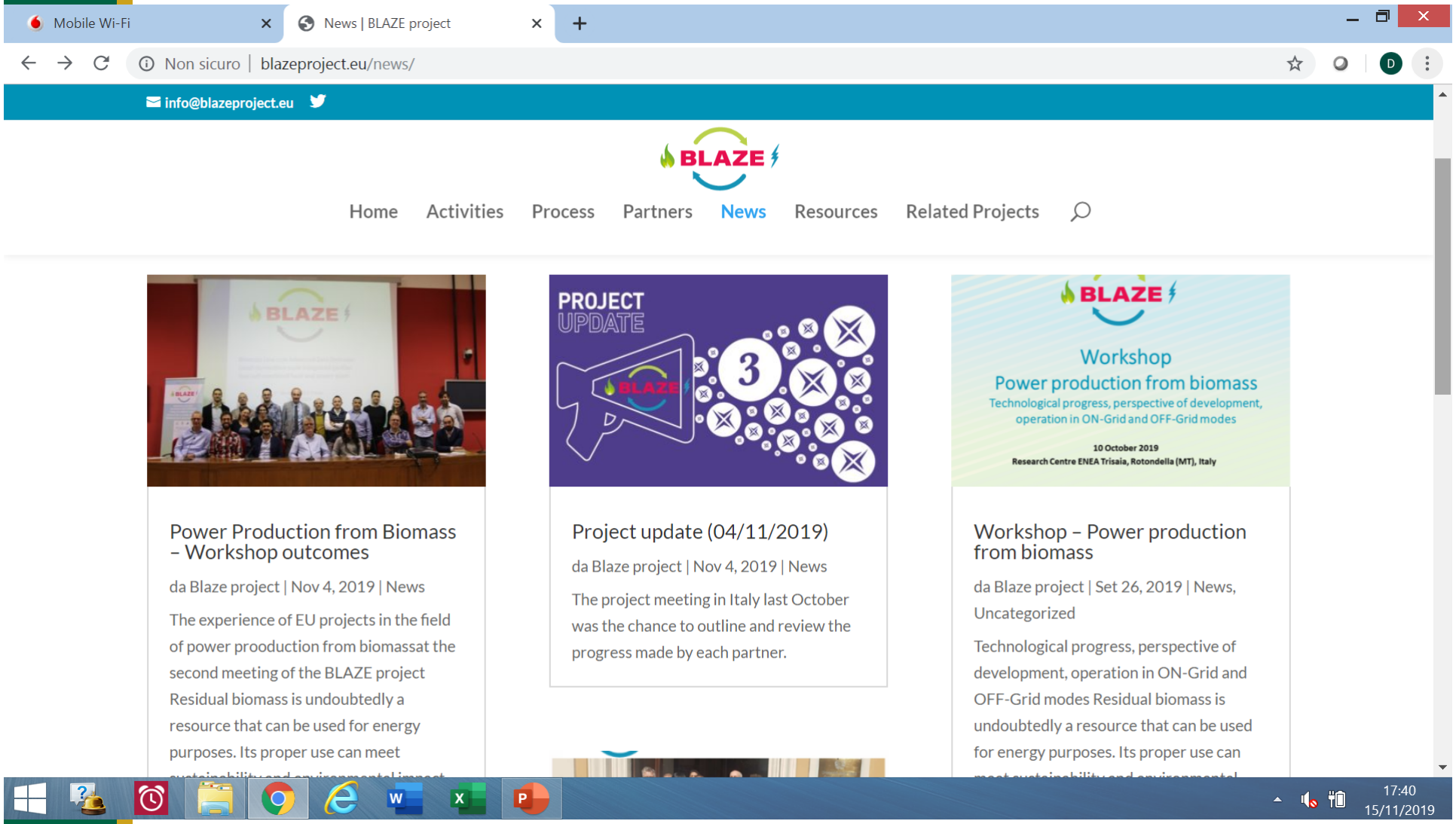
- ✓ Clean and N2-free syngas from a wide rang of feedstocks (the gas will be suitable also for other applications than CHP);
- ✓ Reference range for power production: small (25-100 kWe) to medium (0.1-5 MWe) sizes;
- ✓ CAPEX: ~ 4 k€/kWe (vs current 5.0-10.0 k€/kWe);
- ✓ OPEX: ~ 5 c€/kWh (vs > 10 c€/kWh; using low cost biomass, < 80 €/t);
- ✓ High energy efficiencies (50% electricity vs current 20%);
- ✓ Near zero gaseous and PM emissions;
- ✓ Electricity production costs < 0.10 €/kWh (vs actual 0.22 €/kWh).

PERT diagram



Activities, Updates & News @

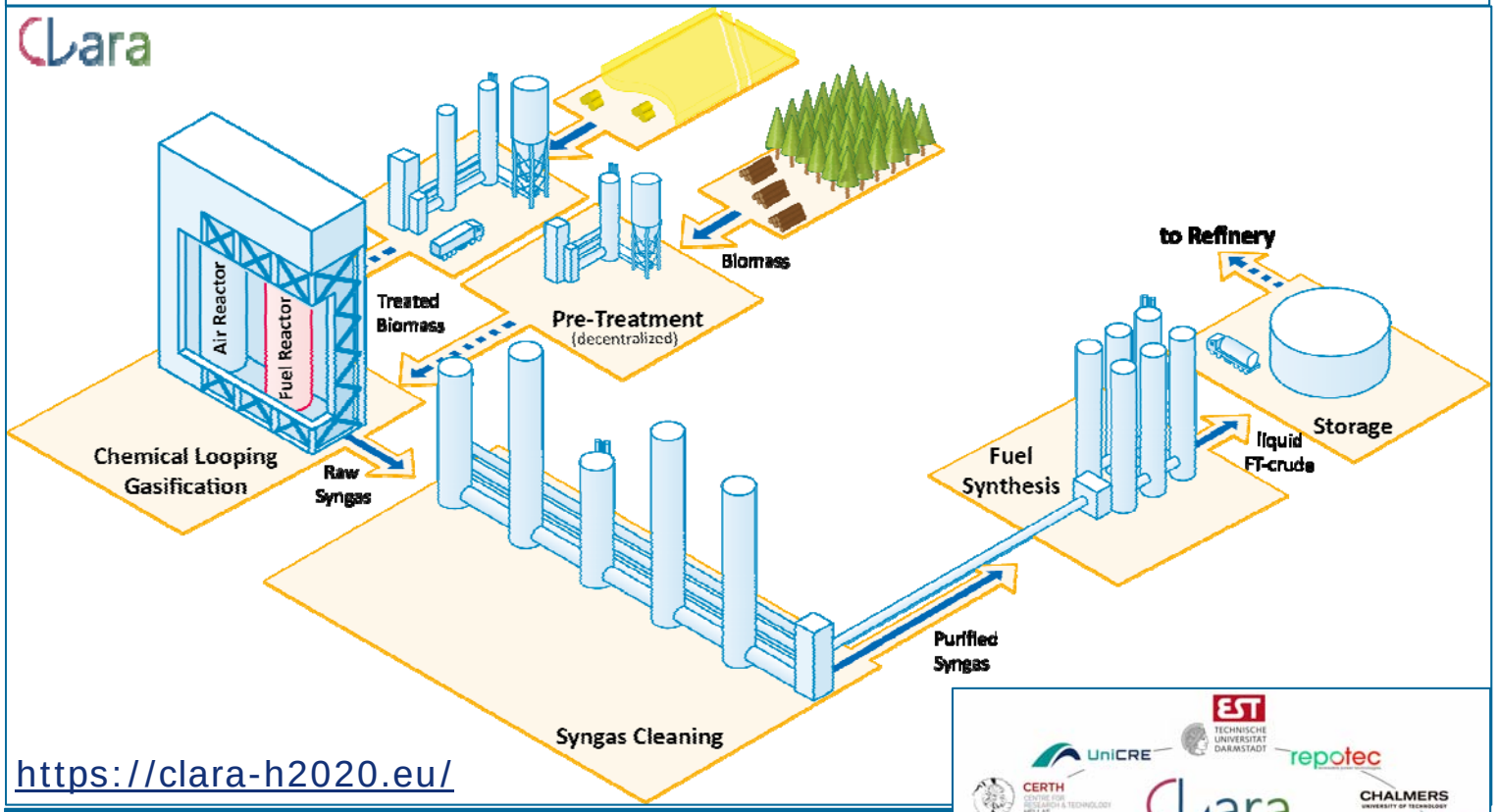
http://www.blazeproject.eu/



IEA Bioenergy www.ieabioenergy.com ENEA

CLARA Project

CHEMICAL LOOPING GASIFICATION FOR SUSTAINABLE PRODUCTION OF BIOFUELS



https://clara-h2020.eu/

H2020 RIA, 5 M€, 11/2018-10/2022, GA 817841
Coordinator: Technische Universitat Darmstadt (Germany)

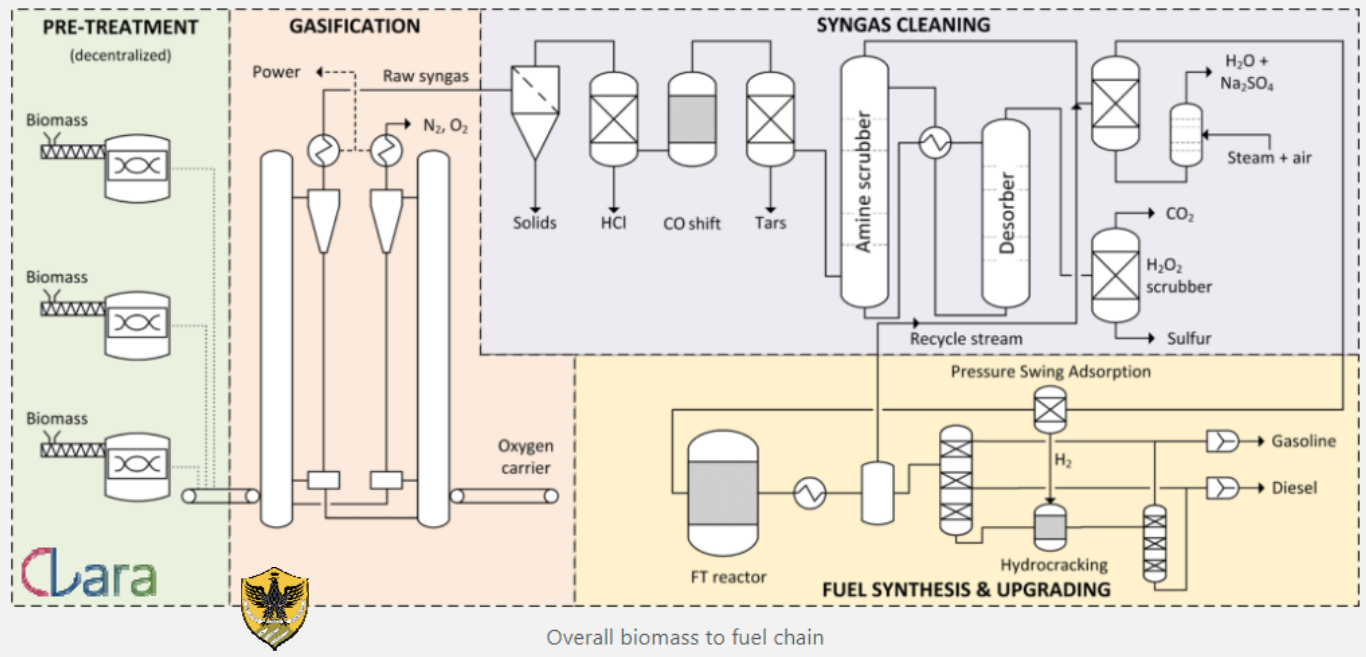
IEA Bioenergy

www.ieabioenergy.com

ENEA

Aim of the project

The overall aim of the CLARA project is to develop an efficient technology for production of liquid fuels based on chemical looping gasification (CLG) from biogenic residues.



Overall biomass to fuel chain

Major objectives:

- To develop and test CLG up to 1 MWth scale in an industrially relevant environment;
- To develop and optimize innovative technologies for biomass pre-treatment and syngas cleaning;
- To demonstrate the entire process chain by pilot tests including hydrocracking of FT wax for drop-in fuel production;
- To conduct process evaluation with respect to risks, economics, as well as its impact on environment and society.

ECOMONDO
THE GREEN TECHNOLOGY EXPO

24a edizione **3-6 novembre 2020** Rimini - Italy

ECOMONDO SETTORI ESPONI VISITA EVENTI MEDIA ROOM ELENCO ESPOSITORI WORLDWIDE

PROGRAMMA **SEMINARI** E **LABORATORI** CONFAGRICOLTURA A ECOMONDO
5-8 NOVEMBRE 2019 FIERA DI RIMINI
PRESSO STAND CONFAGRICOLTURA (AREA 030, PAD. D3 - BIOECONOMIA CIRCOLARE)

14,00 - 15,30
Seminario

Le prospettive di sviluppo della produzione, stoccaggio e utilizzo dell'idrogeno in agricoltura.

Vito Pignatelli - Enea

Idrogeno e biometano: la nuova frontiera delle agroenergie

Bioraffinerie integrate nelle aree locali: stato dell'arte e criticità

Venerdì 8 Novembre 2019
10:00 - 13:45
Memo
Sala Biobased Industry pad.D3

12.15 -13.30 *CALL FOR PAPERS (Pitch 6 min)*

CREDITI FORMATIVI PROFESSIONALI

CIRCULAR BIOECONOMY
Evento Ecomondo - Call for Papers

Biomassa residuale di cardo: caratteristiche della frazione epigeale per utilizzo in processi di gassificazione

Donatella Barisano[1], Francesco Nanna[1], Antonio Villone[1], Cesare Freda[1], Michele Falce[2]
1) ENEA CR Trisaia, 2) Novamont S.p.A.

IEA Bioenergy www.ieabioenergy.com ENEA

Cardoon residual biomass: characterizations of the epigeal fraction for use in gasification processes

Activities are carried out within the aim of the national «COMETA» project

Objectives

Exploring opportunities provided by the gasification process to valorize residual fractions from cardoon in production of:

- Heat and electricity from cardoon and its fractions;
- H2 and CH4 from syngas;
- Biofuels/chemicals through syngas fermentation processes.

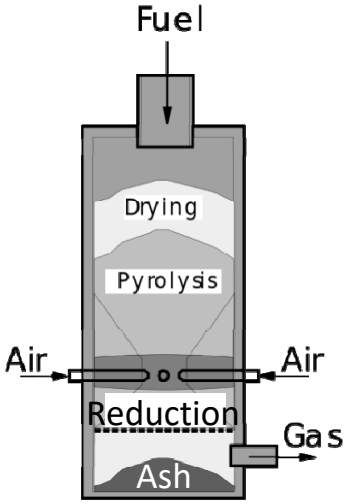
Gasification technologies under evaluation to energy and *biofuels / biochemicals*

1. DownDraft Fixed Bed reactor

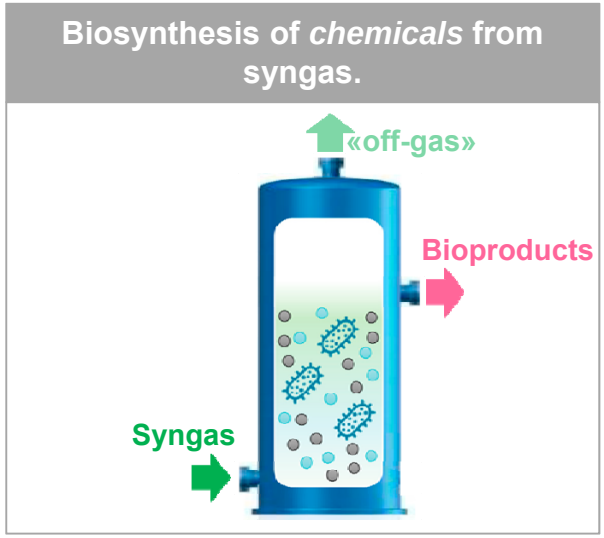
- Gasification with air;
- CHP via ICE;
- Plant small-medium scale, suitable for distributed production and short supply chain.

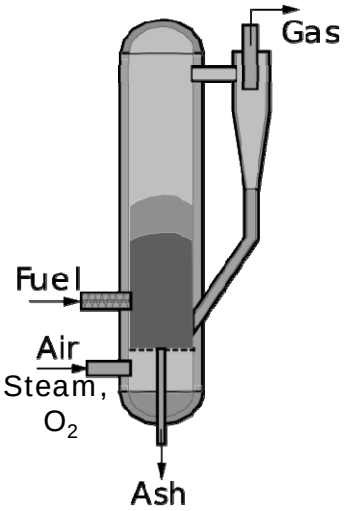
2. Fluidized bed reactor

- Different gasification agents: air, enriched air, steam, steam/O2 (=> N2-Free gas to H2 and CH4, *biofuels* from residual biomass feedstocks);
- Higher flexibility on feed size specifications and process T control (useful with low-melting ash).



In Progress





In Progress

IEA Bioenergy

www.ieabioenergy.com

Country Report Italy

TABLE OF CONTENTS

3

IEA Bioenergy www.ieabioenergy.com

ENEA

Italian context and technology spreading

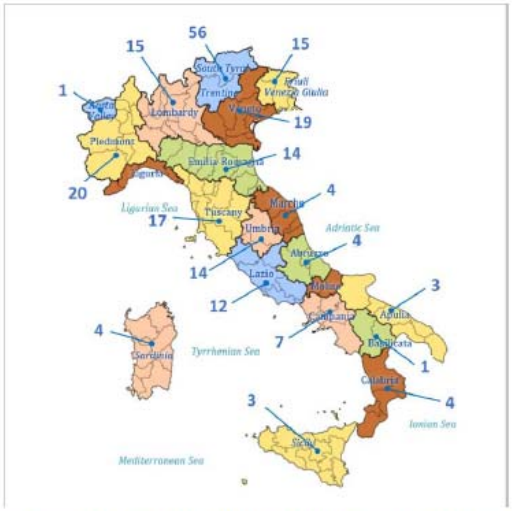


Figure 1. Distribution of gasification plants in Italy (source: data from GSE, 2018[7])

The nominal total installed power amounts to about 43 MWel. Table 1. shows the distribution data among northern, central, southern Italy and islands.

Table 1. Gasification plants installed in Italy.

Geographical area	N° Plants	%	kWel.	%
Northern Italy	140	64.2	32,141	73.8
Central Italy	51	23.4	7,141	16.4
Southern Italy and islands	27	12.4	4244	9.8
Total	**218**	**100.0**	**43,526**	**100.0**

Most of the plants and installed power are located in the area of northern Italy, in accordance with the fact that in this area of the country the presence of forested areas and companies that work wood is significant. Trentino-South Tyrol is the region with the larger number of gasification plants and power production.

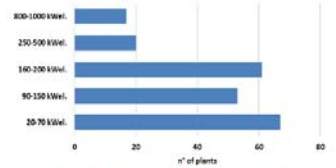


Figure 2. Distribution of the number of plants by size.

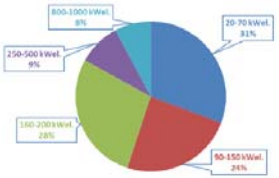


Figure 3. Percentage of number of plants by size.

Based on the identified ranges of electric power, the largest contribution to the total power production comes from the plants in the 160-200 kWel and 800-1000 kWel ranges (Figure 4), which account for 27 % and 36 % of the total (Figure 5), respectively.

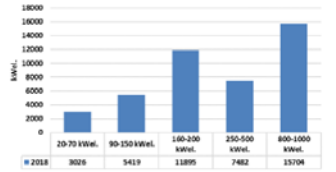


Figure 4. Power distribution by size.

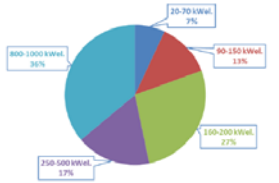


Figure 5. Percentage of power distribution by size.

The total installed power is expected to increase further thanks to the entry into operation of some new plants authorized under the criteria of the decree published by the Ministry of Economic Development on 23 June 2016. As indicated in the section "RD&D programmes to promote the renewable energy sector", this decree is no longer into force.

R&D Institutes

Organization		Dep / Div / Consortium	Base
1	ENEA	DTE/BBC	CR Trisaia-Rotondella (Basilicata)
2	CIRBE	[illegible] Guglielmo Marconi	Teramo (Abruzzo) L'Aquila (Abruzzo) Roma (Lazio)
3	CNR	[illegible] Ricerche sulla Combustione (& Università degli Studi Federico II) Istituto [illegible] Istituto [illegible] Tecnologie Avanzate per l'Energia	Naples (Campania) Messina (Sicily)
4	Libera Università di Bolzano	Bioenergy & Biorefinery	Bozen-Bolzano (Trentino- South Tyrol)
5	RE-CORD	CNR-IVALSA, University of Florence, Az. Agricola Montepaldi, Spike Renewables, ETA Florence, BioEnTech, GAL-START	Scarperia e San Piero – Firenze (Tuscany)
6	SOTACARBO	Sustainable Energy Research Centre	Carbonia (Sardinia)
7	Università degli Studi della Campania "Luigi Vanvitelli"	Dipartimento di Scienze e Tecnologie Ambientali, Biologiche e Farmaceutiche	Caserta (Campania)

Italian SMEs & Market

Name	Technology	Commercial	Size	Base	Markets
CMD SPA	Down-Draft Fixed Bed	ECO20X MICRO CHP SYSTEM	20 kWel/ 40 kWth	San Nicola la Strada (Caserta, Campania)	ITALY
ESPE SRL	Down-Draft Fixed Bed	CHiP50 COGENERATOR SYSTEM	49 kWel/ 110 kWth	Grantorto (Padua, Veneto)	ITALY UK JAPAN
RESET SRL	Down-Draft Fixed Bed	SYNGASMART 50 CHP SYSTEM	50 kWel/ 75 kWth	Cittaducale (Rieti, Lazio)	ITALY

R&D by SMEs

Name	Technology	Name Facility	Size	Plant location
BIOSYN	Down-Draft Fixed Bed (two oxidation areas)	BIOSYN	160 kWel/ 260 kWth	Nave San Rocco (Trento, Trentino)
INTERNATIONAL POLYFUEL MACHINES	Down-Draft Fixed Bed (modified Imbert)	IPM	200 kWel/ 280 kWth	Treviso (Veneto)
ENERITALY SRL	Down-Draft Fixed Bed	RET ENERITALY	72 kWel/ 140 kWth	Cura Carpignano (Padua, Northern Italy)
LEGNO ENERGIA SRL	Down-Draft Fixed Bed	LEGNO ENERGIA	150kWel/ 270kWth	Tirano (Sondrio, Lombardy)
RONDA ENGINEERING SRL	Two stages (pyrolysis & downdraft)	ECOGASGENERATOR	999kWe/ 1320kWth	Val di Vizze (Bolzano, Trentino-South Tyrol)
SITE SPA	Down-Draft Fixed Bed (open chamber)	PIROGASS	150 kWel/ 307 kWth	Treviso (Veneto)
OFFGRID SRL	Two stages (pyrolysis & downdraft)	OFFGRID 4.0	198 kWel/ 232 kWth	Vicenza (Veneto)

Thank you

Contact Details

Donatella Barisano
CR ENEA Trisaia
SS Jonica 106, km 419 + 500
75026 Rotondella (MT)
ITALY

donatella.barisano@enea.it

IEA Bioenergy Website
www.ieabioenergy.com

Contact us:
www.ieabioenergy.com/contact-us/