Fonds Régional de Développement Européen
European Regional Development Fund

ICE
INTELLIGENT COMMUNITY ENERGY

Interreg
France (Channel Manche) England

EUROPEAN UNION

ICE PROJECT OUTPUTS DESCRIPTION

EXCEL GASIFICATION TOOL

MONTH YEAR

BRETAGNE DÉVELOPPEMENT INNOVATION
SDEF
TECHNOPÔLE BREST-IROISE
Technopole Quimper-Cornouaille
PÔLE MER
UNIVERSITY OF EXETER
PLYMOUTH UNIVERSITY
UEA University of East Anglia
marine

ICE report OUTPUT :

Excel gasification tool

Background information

Valorising Waste to energy is the last step, according to the European Union's "Waste Hierarchy", where a valorisation of waste is possible. Landfilling waste (in controlled landfill or not controlled dump) is the main waste treatment in the world, however, waste-to-energy valorisation is almost only performed by "high income" countries (Gross National Income > 11 k$/cap)[1].

In the particular context of isolated territories, fossil fuel is imported to produce electricity, while in the majority of the cases, waste are exported to be properly treated on the continent. These two aspects conduct to high cost for energy production and waste treatment.
The idea is to identify on isolated territory what is the share of waste that could be valorise on site, in order to evaluate the production of renewable electricity and heat, and to design the gasification unit and cogeneration.
In order to provide a solution suitable for big as well as for small territories, the technology selected is the downdraft fixed bed gasification reactor, which known a worldwide development during World War II, and is able to cover electricity production from few kWe up to 1MWe using 1 reactor. A set up in parallel of several reactors allows to reach any power desired.

The idea of the creation of the tool succeeded a study on the Ushant Island to assess the potential of waste wood collected locally and exported, which could be rather valorized on the island, in order to produce renewable energy (electricity and heat).

SYSTEM/TECHNOLOCY SPECIFICATIONS

The tool consists of an excel file, with the aim to provide a quick estimation of a waste-to-energy unit in terms of:

- Quantities of fuel
- Size of the unit
- Energy available : electricity and heat
- Needs in terms of preparation, residues
- Economical estimation (CAPEX, OPEX)

The user of the file need to enter as input data :

- **amounts of wastes, and quality: moisture, ash content, inert content**
- Needs in terms of energy availabity required : all year long or a defined period (e.g. only in winter)
- The characteristics of the territory :cost of importation, current cost of electricity, cost of waste treatment, cost of Full-Time Employee…

[1] D. Hoornweg, P. Bhada-Tata, and A. Joshi-Ghani, "What a waste: A global review of solid waste management," Washington, DC 20433 USA, 2012

ANTICIPATED AND/OR RECORDED IMPACTS/ BENEFITS

The anticipated benefits are :

- Increase knowledges for isolated territories of such technology to both valorise waste, and produce renewable electricity and heat.
- Provoke the emergence of local, small-scale unit in isolated territories
- Increase, in the end, the self-reliance of territories

The use of Ushant as case study for the tool gave the following results :

Context

Total mass of identified waste/biomass - t	Total mass of fuel, inert free (with effiency) - t	Total energy potential - MWh th	Total Electricity Potential - MWhe	Total Heat potential - MWh th (in case of cogeneration)
100	63	313	69	203

Design of the valorization unit

Energy valorization		Minimal Power output of the unit recommended based on the chosen operation rythm - kWe
Electric power output (user's choice) - kWe	10	8,18
Thermal power output - kWth	30	
Total electricity produced - MWh/y	69	
Total heat produced - MWh/y	203	
Hours of operation per day - h/d	24	
Number of operating day per week - d/week	7	
Nombre operating week per year - week-year	50	
Number of working hours - h/y	8400	
Preparation and Storage of the fuel		
Surface occupied by fuel (as received) in the storage 1 - m2	34	
Surface occupied by shredded fuel in the storage 2 - m2	52	
Inert et residues		
Inert removed during preparation phase (status as Waste) -	6,84	
Residues of gasification - t/y	5,00	
Quantities of fly ash (from cyclone or filters) - t /y	0,63	

in grey : fixed parameter, in red : variable to ensure the scenario

Scenario	Non-stop Operation (24/24, 7/7) - 1 annual stop	Operation spread over 1 year + condition : 5 d/week	Operation spread over 1 year + condition : 16 h/d
h/d	24	26,44	16
d/week	7	5	8,26
week/year	40,92	52	52

Economical analysis

Sensibility of incomes vs Elec Price vs Heat Price - in green, when incomes exceeds operational costs

Price of heat - €/MWhth	Price of electricity - €/MWhe						
	100	150	200	250	300	350	400
10	28 000	31 000	35 000	38 000	42 000	45 000	49 000
50	36 000	39 000	43 000	46 000	50 000	53 000	57 000
100	46 000	49 000	53 000	56 000	60 000	63 000	67 000
150	56 000	59 000	63 000	66 000	70 000	73 000	77 000
200	67 000	70 000	74 000	77 000	81 000	84 000	88 000
250	77 000	80 000	84 000	87 000	91 000	94 000	98 000
300	87 000	90 000	94 000	97 000	101 000	104 000	108 000

Capital Cost	275 000	€
Fuel management	97 000	€
Process (energy production)	135 000	€
Ingineering, Construction, Transport	43 000	€

Incomes	61 000	€/y
Electricity - €/y	15 000	€/y
Heat - €/y	27 000	€/y
Revenues as waste treament - €/y	19 000	€/y

* depending on hypothesis of electricity, heat, and waste treatmen tariffs

Operational Cost	74 000	€/y
Fixed Charge	58 000	€/y
Maintenance	6 000	€/y
Salary	50 000	€/y
Other	2 000	€/y
Variable Charge	16 000	€/y
Fuel	0,00	€/y
Self consumption	3 000,00	€/y
Evacuation of Residues	2 000,00	€/y
Loan	11 000,00	€/y

The results given by the tool, are in adequation with the study perform on Ushant, hence confirming the accuracy of the tool.

ANTICIPATED AND/OR RECORDED CHALLENGES

The anticipated challenges are :

- Territories must have the will to take in charge this project
- On the renewable energy point of view : Valorising waste to energy is not as easy as installing photovoltaic plant or windmill, although it can produce energy regardless of the external conditions : night/day, winter/summer… as long as there are waste/biomass available.
- On the waste treatment point of view : Valorising waste to energy is sometimes considered as incineration, which requires high level of pollutants controls, which are expensive for a small unit, and for an isolated territories.