

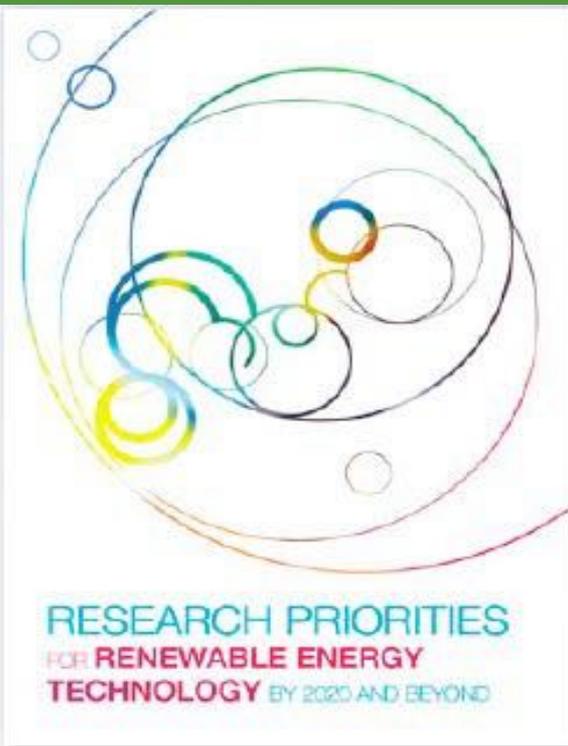
# PRESENTATION

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Our Awards





[www.eurekanetwork.org](http://www.eurekanetwork.org)

[www.eurogia.com](http://www.eurogia.com)

[www.eurec.be](http://www.eurec.be)

Since 2012 all landfills are banned in the European Union. All waste must be conveyed to a special recycling plant. In 2009 Agency EUREC (an association of publicly funded research institutions) in the European Union issued a policy document entitled *Research Priorities for Renewable Energy Technology by 2020 and Beyond* for the European Commission. In particular, it states: “**Advanced gasification processes should be developed for power and hydrogen and/or syngas production using biomass-fired integrated gasification combined cycle turbine plants. Gasification needs to be demonstrated for small-scale, decentralised applications**”.

# Structure of household and industrial organic waste



Agricultural waste



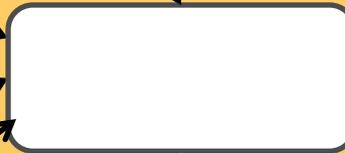
Paper and Pulp waste



Textile waste



Wood waste



Food waste



Polymer waste



Petroleum waste

# The general structure of household and industrial organic waste

- **40 - 55% wet food waste**
- **7 - 12% used tires**
- **5 - 10% the paper**
- **2 - 5% textiles, cloth, leather**
- **4 - 6% polyethylene (PE)**
- **1 - 3% polystyrene (PS)**
- **2 - 4% polypropylene (PP)**
- **3 - 5% polyethylene terephthalate (PET)**
- **1 - 4% rubber**
- **1.5% polyvinyl chloride (PVC)**
- **up to 5% of oil sludge and waste oil**

# Existing technologies for recycling of organic waste

- Target use of certain components of sorted waste
- Storage in landfills
- Conversion by means of biological methods
- Burning
- Incineration
- Plasma gasification
- Pyrolysis
- **Gasification (steam or thermal in a small size gasifier)!**

COMPETITION  
THIS IS EU STATE OF  
THE ART GASIFIER  
TECHNOLOGY



Gas Cleaning

40 m drying belt..



12 m

200 kW<sub>e</sub>  
€ 1.2 million



# Finnish gasifier 'Volter' in Scotland (2017)

(only for wood)

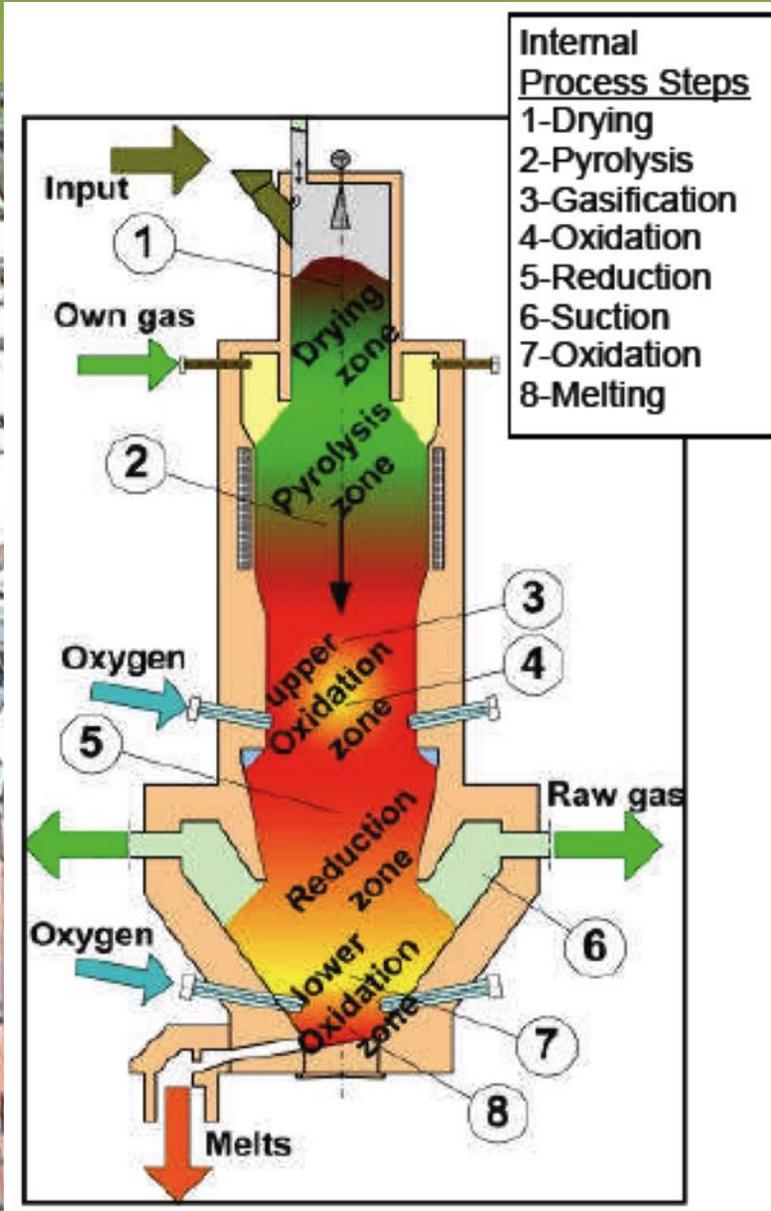
price: 250 000 Euros



Erosion of  
the metal



# HTCW (High Temperature Conversion of Waste, Germany) *Other companies*



BlueShellEnergy  
WST International  
(Holdings) Limited

Sher Technologies

BAVIRO

KleanIndustries

Covanta Energy

arc21

Kawasaki Techn.

Energos

HGA

Cortus AB

UE KOREA

- Studies on gasification continued in Ukraine after the Second World War, unlike all other European countries;
- By the middle of 1964, more than 3,000 gasifiers were operating in Ukraine, each with a capacity of 1 MW;
- Brezhnev's era started in Ukraine with the cutting of all gasifiers for scrap and bringing to Ukraine natural gas from Siberia;
- We use the previous developments of Ukrainian scientists and now has the most advanced technologies in gasification.

# Examples of our previous pyrolysis plants



← In the city of  
Luhansk

In the city of Mykolaiv →



# Our models of thermal gasifier



50 kg/hour, 2009



30 kg/hour, 2015

Kyiv

**Our gasifier  
70 kg/hour**

**Kyiv**

**The first start was  
16 Nov 2016**

















The gasifier consumes 1 kWh of electrical power - for electronics management.

The temperature in the reactor is 1300-1600 °C

Dirty waste but  
no smoke -- the  
clean exhaust.





Slag and ashes pour out  
on their own

Slag from gasifier  
is a great material  
for building  
industry:  
dripping  
admixtures for concrete  
products, asphalt



# Key features

- ✓ Depth of processing is 99%
- ✓ High-energy synthesis gas
- ✓ Allows high moisture content
- ✓ Extremely low emissions
- ✓ Allows low carbon content
- ✓ Low cost of construction
- ✓ Small foot area under the gasifier
- ✓ Unnecessary ramified infrastructure
- ✓ Gasifiers can be designed for 50-1000 kg/hour

# Comparison Table of Gasification Technologies

		Air blown gasifier Fixed Bed	Steam blown gasifier Fluidised Bed	Oxygen blown gasifier Entrained Flow	<b>Our technology</b>
Calorific Value	MJ/N m <sup>3</sup>	4-6	12-14	10-12	15-19
H <sub>2</sub>	%	11-16	35-45	23-28	35-45
CO	%	12-18	22-25	45-55	45-55
CO <sub>2</sub>	%	12-16	20-23	10-15	10-15
CH <sub>4</sub>	%	2-6	9-11	<1	<1
N <sub>2</sub>	%	45-60	<1	<5	<3

**Recycling rate 40 – 70 %  
(at application to municipal solid waste)**

**Recycling rate  
99 %**

# Tenneville (Belgium) – Garbage Recycling Plant

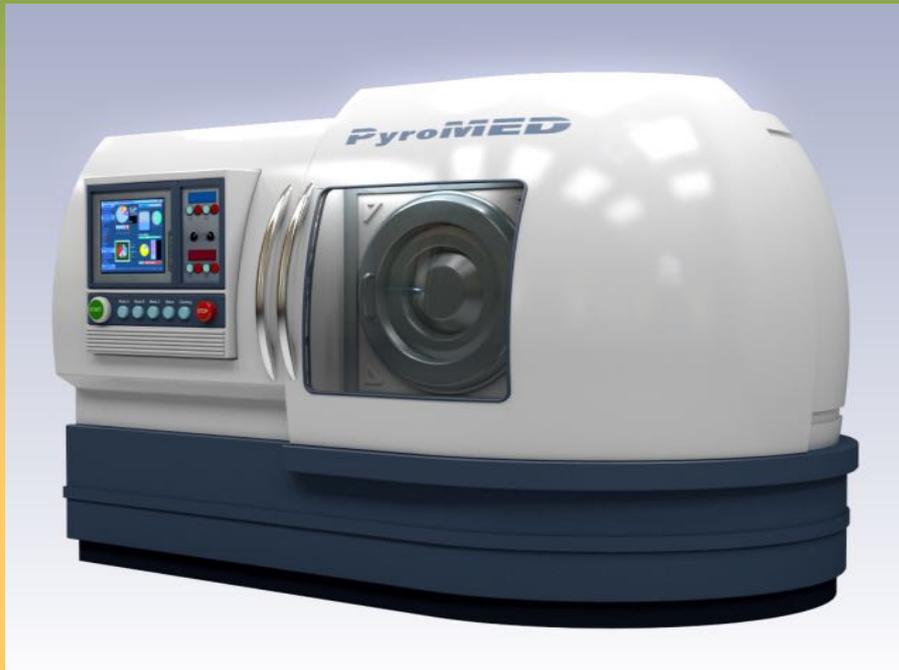
Capacity of the plant is 30 000 tonnes / year



# Comparative Table

	Tenneville technology	OUR TECHNOLOGY
<b>Capacity of the landfill</b>	30 000 tons / year	30 000 tons / year
<b>Generation of electric power</b>	600 kW	2.5 MW
<b>Cogeneration of heat</b>	1 MW	10 MW
<b>Investment cost of 1 kWh of electricity</b>	28 000 Euros	3 000 Euros
<b>Productivity</b>	3.5 ton / hour → 600 kW (electric) or 2.4 MW (heat)	3.5 tons / hour → 2.5 MW (electric) or 30 MW (heat)
<b>Depth of processing</b>	40%	99%
<b>Solid / liquid residue</b>	18 000 tons /year	300 tons / year
<b>Size of the gasifier</b>	3000 cub. m, height 25 m	small foot area, height 2.5 m
<b>Investment price</b>	17 million Euros	7 million Euros
<b>Feed back period</b>	about 20 years	4 years (electricity) 2 years (heat)

# Gasification of medical waste (design)



# Possible design of gasifiers for recycling of organic waste



It can be possible to provide  
mechanical conveyor of  
garbage

# reference data

1 kg of organic waste  $\leftrightarrow$  1 cubic m of gas

1 cubic m of gas from waste  
 $\rightarrow$  0.25 cubic m of natural gas

1 cubic m of natural gas  $\leftrightarrow$  9.26 kW of energy

1 kWh = 0.00086 Gcal

The price of 1 Gcal is 1400 Hryvnas (\$50)

**1 gasifier with the productivity of recycling 100 kg of waste per hour generates the energy, which is equivalent to the energy produced at the burning of 330,000 cub. m of natural gas.**

**Consider a city (like Tenneville above)  
producing municipal solid waste  
30,000 tonnes per year**

Then per a day the city produces 1250 tonnes.  
Per for 1 hour produces 3.5 tonnes.

**For example, we can put in the city 22  
gasifiers each with a waste recycling  
capacity of 200 kg / h.**

**For instance, by two gasifiers in ten points.**

The investment needed is \$7 million

By energy, 2 kg of organic waste is approximately equivalent to 1 cubic metre of natural gas. THEN:

per  
one hour 3.5 tons  $\approx$  900 cub. m of natural gas

per  
one day, 85 tons  $\approx$  21,600 cub. m of natural gas

$\rightarrow$  160,000 kWh  $\approx$  137 Gcal  $\leftrightarrow$  240,000 Hryvnas

**The city earns per year:**

**240,000 Hrn. x 365 days**  
 **$\approx$  86,600,000 Hrn.  $\approx$  \$3 million**

In the case of Lviv (UAH 1,400 / Gcal), the daily amount of household organic waste is 600 tons, which is energy equivalent to 159,000 cubic m of natural gas. This is the equivalent

$1,176,600 \text{ кВт}\cdot\text{год} \approx 1,646 \text{ Gcal} \leftrightarrow 2,3 \text{ million of Hryvnas}$

In a year Lviv's garbage will bring the following energy and, accordingly, income :

circa 58 billion cub. m of natural gas

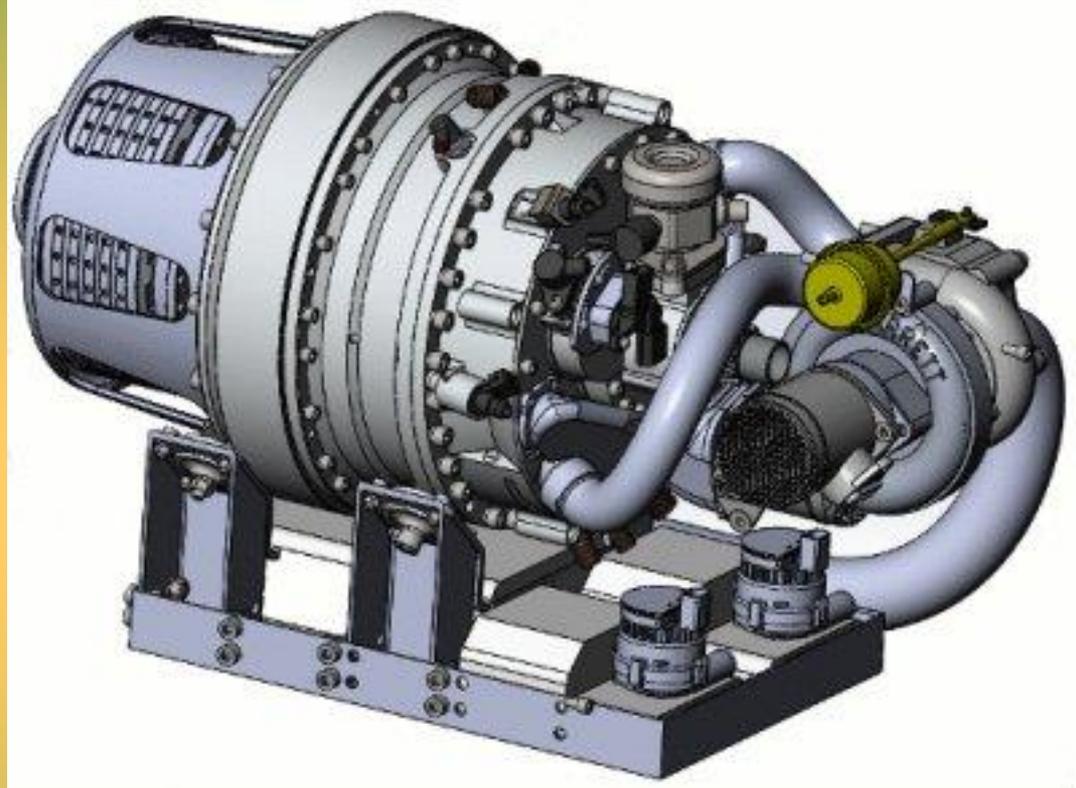
$0,43 \times 10^6 \text{ kWt h} \approx 370\,000 \text{ Gcal}$

$508,750,000 \text{ Hryvnas} \approx \text{\$20 million}$

Currently, Lviv spends \$11-12 million annually for removal of municipal solid waste and storage it at the landfill...

There is the possibility also to generate electric energy directly from the syn-gas obtained in the gasifier, which can be done using a hybrid rotor turbomotor

Then efficiency of generation of electric energy is about 50%.



The exhaust, i.e.  $\text{CO}_2 + \text{H}_2\text{O}$ , can be directed to a greenhouses, which significantly activates the grow of vegetables (and grass from grain for domestic animals – up to 20 cm tall per 24 hours).

# A potential market for our technology in Ukraine

**--- In Ukraine, more than 400 million tonnes of organic waste has already accumulated in landfills (equivalent to 200 billion cubic metres of natural gas), which require urgent processing into energy.**

**--- Every year in Ukraine, over 18 million tonnes of new organic waste is formed (equivalent to 10 billion cubic metres of natural gas).**

# A potential market for our technology in Western Europe

Medical waste: in Europe, 14 thousand clinics

**Municipal waste:** annually created in Europe  
84 million tonnes of carbon containing waste.

The energy that can be obtained from these wastes is equivalent to the energy generated by 16 units of nuclear power plants with a power of 1 GigaWatts each.