NCL Group s.r.l.
Via Morolense - Loc. Monticchio
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Subject: LETTER OF PRESENTATION and OUR COMPANY REFERENCES

We hereby enclose a brief profile of our corporate structure, trusting to count you among our customers.

We remain at your disposal and the opportunity to extend our most

Cordial greetings.

COMPANY PROFILE:

- Company: NCL Group s.r.l.
- Legal Headquarters: Via Morolense - Loc. Monticchio 03013 Ferentino(FR) - Italy
- Operational Headquarters: Via Morolense - Loc. Monticchio 03013 Ferentino(FR) - Italy
- Phone: +39 0775 223166
- Fax: +39 0775 223926
- Share capital: € 1.195.000,00
- VAT number: 00302310602
- e-mail: info@nclgroup.it

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About Us

The NCL Group was founded in 1982 for the production of cement and quarrying activity today is at the top of the demolition, favored both by the government policy and common time to encourage the redevelopment of old brownfield sites to be converted into residential areas, and the actual need for additional space to accommodate the new and commercial facilities, all with the use of advanced techniques, responsible for the analysis for the intervention of the relevant areas of demolition including all stages of removal and disposal of hazardous substances in approved landfills.

In addition to the simplified procedures you can replace the demolished waste in the site or other areas, all without leaving any evaluation to the case for a real professional and not improvised.

The NCL Group has conquered the place as the first company in the south center that operates in this particular sector at the national level with immediate answers to 24 hours 24 to any public and private emergency procedures for recovery disaster areas by collapses and natural disasters such as floods, earthquakes and landslides.

In addition, the NCL is present in other areas of the building such as earth moving, dredging canals and reservoirs, topographic and geological and other services.

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Our goals

The main objective of the company is customer satisfaction and creation, from the beginning, of a clear and serene relationship.

At the heart of our efforts is the customer who:

- Obtain a good technical advice on the most suitable solution to his needs.
- To be informed of how it will develop the work from design to construction, from installation to after sales service.
- Having the best product, the result of ongoing research of the best materials available on the domestic and foreign market.
- Enjoy total control during processing and the security of an installation in a workmanlike fashion by qualified and up to date on all the circumstances of the product.

NCL Group

The NCL Group is formed by several companies operating in specific sectors. The main companies are:

- **N C L Group s.r.l.** (demolitions, landfills, quarries)
- **SE.IN. s.r.l.** (recovery and disposal of waste)
- **Arcese Norma s.r.l.** (Quarries and inert)
- **Mineraria 3C s.r.l.** (carbonates and micronized)
- **PICK SPA** (production of technical mortars for construction)
- **Ecorubber** (**recycling of tires)**
- **Centro sportivo Ali Cocco** (recreational activities)

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Operating Segments

The companies of the group NCL operate mainly in the following areas:

- ### Reclamation

  Reclamation activities must be carefully studied, planned and implemented with inspections of the territory to obtain the status and history of the pollutants that have affected land and any slopes. The removal of materials and hazardous materials from plants and soils is a priority to which the NCL is able to cope thanks to the contribution of the subsidiary SE.IN. srl based in Morolo (FR).

- ### Demolition civil and industrial sites

  The NCL Group s.r.l performs large-scale demolitions in industrial areas by converting the area for new settlements recycling on-site raw materials with simplified procedures.

  In the event of a total demolition of the plant all materials are removed and transferred to disposal centers until reset on ground even in its natural state.

  The NCL Group s.r.l executes demolitions of partial type for structures damaged by injury, fire, natural disasters or changes of use with a wide range of machines from the technical characteristics of high precision and highly effective in protecting and respecting the environment, working with soundproof crushers, demolition constant powders. The renovation and the addition of new media bring the NCL Group Ltd. to be always up to date.

  Currently we have excavator arm with standard and special excavators up to 24 meters equipped with pliers, shears and crushers of various sizes. Wheel loaders and crawler fast-moving all in coordination with the means to transport standard and exceptional.

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Controlled demolitions

Controlled demolitions are carried out with explosives or with special platforms.

For the use of explosives the N C L Group s.r.l uses the collaboration of the company SIAG Ltd.

Recycling waste materials

The demolition, especially when referred to large areas, produces a considerable amount of debris that can be recycled. The N C L Group s.r.i. is able to cater to this process through the sorting of the materials, and then start them to local recycling facilities (reinforced concrete, bricks, paving etc.) or the blast furnaces (ferrous materials, steel etc..), or, alternatively, may execute the Recycling On-site thanks to the most modern and efficient mobile systems sorting and crushing with on-site reuse of the recycled material by means of simplified procedures.

Recycling used tires

When a tire no longer has the characteristics necessary for a safe and efficient performance, even through the reconstruction, it becomes **"out of order"** - meaning a rejection - and is sent to the **collection** and **recovery**.

For the recovery of **materials** and **energy** from "used tires" NCL group has gained considerable know-how and technical facilities through operational and organizational level, in relation to the management of the "chain" for **tracing**, the **collection**, **treatment** and the **final destination** of Life Tyres.

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Our Services

NCL Group s.r.l is able to offer customers a wide range of equipment and services with the utmost care, technology and high quality.

Here are some of the equipment and services offered:

- ***Demolition civil buildings***
- ***Demolition brownfield sites***
- ***Partial demolition***
- ***Controlled demolition of chimneys and buildings by explosives***
- ***Inert landfill***
- ***Collection and transport of special waste inert***
- ***Waste recovery in companies***
- ***Reclamation disposal asbestos-cement***
- ***Pliers for cold cutting of metal structures***
- ***Certification of soil and groundwater***
- ***Reclamation and demolition chemical plants***
- ***Reclamation and neutralization polluted soils***
- ***Drainage channels and reservoirs***
- ***Environmental restoration of degraded areas***
- ***Reuse inert either on site or on other sites***
- ***Reuse the milled highway***
- ***Earthmoving, earthworks and carry***
- ***Exceptional transport***
- ***Rental shovels***
- ***Rental excavators***
- ***Rental trucks***
- ***Rental boxes scarrabil***
- ***Rent construction equipment***
- ***Supply of washed and not washed aggregates***
- ***Pumping and supply of ready-mixed concrete***
- ***Production of cement***
- ***Granules calibrated carbonates micronized for industry***
- ***Topographic and geological***

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Partner

Below are the main partners of NCL Group, of which, apart from, you are given information sheets relating to the assets subject to partnership.

MARANGONI tyre machinery

sein

inneco innovazione ed ecologia

arreco SOUTH EASTERN EUROPE

Renewable Power Development EUROPE, s.r.l.

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Attachments

Attachment 1 Marangoni - C.U.T./T.U.T. Burning and electric power generation plant

Attachment 2 Marangoni - Tyre to energy plant

Attachment 3 Inneco - Worn tyres: a second life

Attachment 4 Asseco – Company profile

Attachment 5 Asseco – RecityrePlus - Function Diagram

Attachment 6 RDPE – Global Environmental Energy Solutions

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Attachment 1

MARANGONI™
tyre machinery

C.U.T./T.U.T. Burning and electric power generation plant

C.U.T./T.U.T. BURNING
AND
ELECTRIC POWER
GENERATION PLANT

(2000 kg/h)

PLANT GENERAL SPECIFICATION

1. GENERAL

This document describes the main characteristics and the operation of a 3.300 kW (gross capacity) electric power generation plant which utilises recovery of heat coming from 2000 kg/h C.U.T./T.U.T. (Car Used Tyres/ Truck Used Tyres) burning. This occurs with the combustion of whole tyres in a rotating furnace, from that the fumes are sucked in the steam generator. The fumes, after the filtration, are evacuated through the chimney, on them are monitored the amount of stack emission.

This specification includes all the plant technical main information, its operation description, control system and power electric distribution system characteristics.

The above described plant foresees C.U.T./T.U.T. burning with heat recovery for electric power generation only: part of this electric power is utilised by the plant auxiliaries (fans, pumps, etc.), the exceeding part of it can be given to the network or can be utilised for other technological utilities.

This plant is foreseen to be constructed inside a building. Some components, such as cooling towers and flue gas filters, shall be installed outside.

It is foreseen an emergency electrogene group (i.e. in case of network failure and turbine stop) with a power which can keep the services necessary for more critical equipment protection (furnace and boiler) working.

Since generally it is not known neither the place where the plant shall be installed nor the relative ambient conditions, some systems such as cooling towers, compress air, industrial and demi water shall be evaluated and redimensioned each time.

2. PLANT COMPONENTS

The plant consists of the following components:

- U.T. conveyor system (Car and Truck)
- C.U.T./T.U.T. furnace and afterburner
- Hot flue gas by-pass
- Recovery boiler or HRSG (Heat Recovery Steam Generator)
- System for the extraction of steel wire and ashes
- Flue gas suction and stack
- Bag filters
- Turbogenerator
- Thermal cycle components
- Power electric plant (transformers, electrical boards, cables)
- Electrogene group
- Control room (Control and supervision system)
- Demi water system
- Continuous monitoring system of stack emissions

2.1 C.U.T./T.U.T. conveyor system

The U.T. conveyor system, both for C.U.T. (car tyres) and for T.U.T. (truck tyres) to the furnace foresee a system for the stocking, singularization and movement of tyres from the discharge/collecting zone to the furnace opening.

The lines are foreseen with following characteristics:

- Steel trip for the automatic stocking
- “cascade system” for the singularization
- trip and roller for the movement to the burning

Both of lines ends with a balance that is the element for the control of the fuel load.

The system is able to assure automatically a autonomy of about 16 hours.

Normally this kind of plant needs a stocking basin for the U.T. (separated in car and trucks), with a grabbing crane for the movement of tyres to the automatic charge system: all this is excluded from the supply.

2.2 Furnace

The C.U.T./T.U.T. are burned in a cylindric rotating furnace which is made of carbon steel and internally coated with refractory material.

The rotation is carried out on rollers with bearings and is controlled by means of only one system equipped with an electric motor controlled by a frequency converter (variable speed 0÷2 rpms)

The furnace has a C.U.T./T.U.T. feeding opening with a shutter gate equipped with an actuator with local control.

The main combustion air shall enter the furnace by means of downstream fan draft.

Two fans with regulating valve, which directly send combustion air into the furnace, are foreseen: the former will be on the feeding front part which is also the fan for preheating burner, the latter on the furnace ending part which blows air between rotating and fixed part.

The furnace will be equipped with two retractable type natural gas fed burners: one is designed to dry refractory material and the other one to preheat.

2.3 Extraction of steel wires and ashes system

In the furnace lower ending part it is foreseen a hopper to extract wires and ashes which are conveyed throughout a steel conveyor belt to a wires/ashes vibrating separator. The ashes and wires are collected separately in boxes under the vibrating separator.

On the terminal parts of the vibrating separator is present a system for the cooling of ashes and wires with water atomiser.

2.4 Hot flue gas by-pass and afterburner

The afterburner consists of a steel tube internally coated with refractory material and it is equipped with a natural gas burner able to start when the temperature inside the burner decreases till under 960 °C, or to take part in heat production for steam generation with a maximum thermal load equal to 10% of plant capacity.

The flue gas by-pass is placed at afterburner outlet. It is a steel made stack internally coated with refractory material and equipped with a valve (clapet) at the top with servo control and counterweight which starts during emergency conditions under regulating system control. Its function is to “protect” the boiler and all the plants downstream of it against the thermal inertia in case of plant stop.

2.5 Heat recovery boiler

The Heat Recovery Steam Generator or HRSG produces steam by taking heat from flue gas.

The HRSG consists of radiant chamber, economiser, boiler and superheater. The superheater has a desuperheater for temperature control. The lower part of the boiler is equipped with hoppers and screws to collect, extract and discharge ashes into suitable containers.

It can produce 16 ton/h of superheated steam at 435°C a nd 43.5 bara through the recovery of heat from the fumes, that income at 980°C and go out at 170°C.

For the internal cleaning is foreseen a “hammer” technology for all the tube nest; for the radiant chamber walls are foreseen pneumatical vibrators.

2.6 Flue gas suction and treatment, stack

Suction and flue gas treatment system consists of all the equipment placed between the boiler Eco flange and the stack.

The flue gas treatment is divided into two bag filters groups with hoppers, rotocells and extraction screws: the first group for ashes filtering and the second one for dry desulphuration with two fans. One fan is upstream of the filters (master fan) and the other one is downstream of them (secondary fan). The master fan, equipped with regulating system must keep the furnace inlet draft constant and must overcome the furnace and boiler head losses.

The secondary fan pushes flue gas into the stack and keeps filters inlet draft throughout an automatic regulating valve on suction.

The desulphuration is obtained throughout mixing (by means of a static fluodinamic mixing) and reaction of flue gas with sodium bicarbonate (NEUTREC® process by SOLVAY) and subsequently by their filtering through bag filters.

On the flue gas treatment line some plant protection systems are foreseen:

- an emergency stack downstream of master fan in front of the filters. It will be controlled at opening in case of filtering system stop caused by bags breaking or by too high temperature of flue gas;
- a “false” air suction valve at inlet of each filters group to control temperature when it is too near the bags materials resistance limit.

A silencer is foreseen between the secondary fan and the stack which is made of steel.

The flue gas treatment system must guarantee that the emission should be in accordance with the 133 - 11.05.05 law (Dir. 2000/76/CE).

2.7 Turbogenerator

The condensing type turbogenerator which has a capacity equal to 3.300 kW at terminals is of package type, assembled and wired on a sole basis.

It is equipped with steam bleeding system to deaerator and it is designed with condenser under it, longitudinally placed in respect of the turbine axis.

The turbogenerator group includes all the services necessary for correct and safe operation (oil box with start-up pumps, working and emergency, oil refrigerators and alternator, barring device, empty system, steam seals system, speed pressure electronic control).

2.8 Thermal cycle components for condensing turbine

Thermal cycle components are all the components that contribute to convey steam to the turbine and therefore to the condensation, outgassing and boiler feeding water.

The components foreseen on plant will be the following ones:

- No.1 under-vacuum main condenser including an empty system (incondensables extraction ejectors) with condenser
- No.1 atmospheric auxiliary condenser including hydraulic control and nitrogen automatic preservation
- No.2 condensate extraction main pumps
- No.2 condensate extraction auxiliary pumps
- No.1 deareator with box for condense cumuling
- No.2 feeding pumps
- No.8 evaporative cooling towers equipped with concrete made tanks
- No.2 condensers water circulation pumps
- Turbine by-pass valve
- Valves and piping
- On site and movable instrumentation
- Chemical injection for the heat generator
- Cooling tower water treatment system
- No.2 integration to the deareator demi pumps
- No.1 emergency integration to the deareator demi pump

2.9 Electric system components

The electric system is distributed on three cabins:

- The delivery cabin where the electric boards for measurement are foreseen
- The power cabin where the following components are foreseen:
    - Start-up and operation working transformer 20KV→380V

- M.V. 6KV electric board (generator leg and Y)
- Equipment protections board and measurement converters
- Power centre board (PC)

- The electric boards room which shall be placed near control room and where are foreseen:

  - MCC boards (motor control centre)
  - Battery charger - batteries - inverter

2.10 Electrogene group

It is a diesel group with automatic start-up system which is activated when there is no other electric feeding on the plant.

It has to feed the more critical machinaries, that is the furnace and a boiler feeding pump, and to keep them working with an autonomy of two hours.

2.11 Cooling towers

For the cooling of the circulating water are foreseen forced draught cooling towers, that are able to keep the nominal temperature value all the year.

They are realised with zinced or inox steel, and are placed on a concrete basin that is the cumuling zone.

The water consumption for evaporation and dragging is about 20 m^3/h, in addition to about 10 m^3/h for drain, all is about 30 m^3/h.

2.12 Supervision and control system, control room

In the control room the following equipment shall be installed on a console:

- Supervision and control system with DCS type
- Turboalternator controls with:
  - command and control board
  - manual and automatic synchroniser
  - excitation instruments
  - measurement instrumentation (voltmeter, amperometer, power factor indicator)

2.13 Demi plant

The demi water plant (including degassing and adjustment systems) shall be able to integrate water and steam bleedings by supplying a quality of the produced water which is always constant.

This system is complete with acid and soda stocking tanks, demi water stocking tank and neutralisation system for the regeneration water.

2.14 Continuous monitoring system of stack flue gas emissions

On the furnace a continuous flue gas monitoring system is foreseen in accordance with the DMA 503 of 19/11/97 related to the actuation of European law 89/369/CEE and 89/429/CEE.

Therefore will be foreseen:

- Connections with the final chimney for the probes
- Probes + interfaces system for the analizator
- Output signal for the automatic control of the monitoring system (optional)

The principal board will be installed as next as possible to the chimney.

3. EXCLUSION

From the supply are excluded

- All the civil works (basin, building, basements, electrical cabine, etc.)
- Plant for production and net for compressed air
- Industrial water and fire net
- Bridge crane or other grabbing crane for the handling of tyres in collecting and stocking area
- Boxes for the collecting of steel and ashes
- Methane reducing station and line till the limits of the burner
- Service plane and stairs in metallic carpentry different from the expected on the components
- Drain net
- Internal and external rooms lighting

4. PLANT MAIN SYSTEMS

4.1 Fuel-air-flue gas system

It is an “open system”.

The C.U.T/T.U.T. fuel and combustion air are introduced at furnace inlet.

The hot flue gas produced in the furnace go through the boiler exchangers (superheater, piping bundle evaporator, economiser) and here they cool. Then they are intake by a fan through the ashes and desulpherating filters and finally go off the stack.

Two emergency stacks that are normally out of service are foreseen: the hot flue gas by-pass which permits to directly discharge in the atmosphere the flue gases before entering the boiler and the stack downstream the master fan which protects the filters against possible high temperatures.

4.2 Water-steam system

It is a “closed system”.

The deaerated water is pumped into the boiler through the economiser at a temperature of about 110 °C and pressure of 1.5 bar. In the boiler it is generated a steam of about 45 bara which is then superheated up to about 435 °C in the superheater.

The steam goes through the turbine generating electric power, it is discharged to the main condenser (under vacuum) and re-pumped to the deareator.

On the connecting line between the exit of the superheater and the collector to the user is foreseen the detaching for the by-pass valve, that permits the starting of the steam generator and the maintaining of the function of the steam generator if the steam user are not working.

The by-pass valve discharges in the auxiliary condenser.

From the deareator suck the feeding pumps that pump the water in the entry lines of the steam generator, with the level regulating valve.

4.3 Circulating water system

It is a “closed system”.

For the condensing of the steam in the condenser (principal and auxiliary) and for the closed cycle cooling system (oil turbogenerator and alternator refrigerant) is adopted a circulating system with cooling towers.

The system is constituted on:

- No. 8 cooling towers
- No. 8 axial fans
- N.2 vertical circulating pumps.

5. STANDARD REFERENCE DATA

5.1 Ambient and operative conditions

Max. temperature	+40	℃
Min temperature	-5	℃
Averaged relative humidity per year	60	%
Operation (46 weeks of 7 days)	7728	h
Normal winter stopping (Christmas)	2	weeks
Normal summer stopping (August)	4	weeks

5.2 Operation data

Tyres feeding system

C.U.T.

Nominal flow	2000	kg/h
Max. dia.	800	mm
Max. height	350	mm
Weight	6÷7	kg
Collection type	in bulk	
Averaged weight/volume	100	kg/m³

T.U.T.

Nominal flow	2000	kg/h
Weight	60÷70	kg
Max. dia.	1400	mm
Max. height	460	mm
Collection type	in bulk	max.

The plant is foreseen to operate at 100% C.U.T. load. The percentage of T.U.T. can be changed by the operator from 0 to 100% when T.U.T. are used instead of C.U.T.

Furnace

Opening negative pressure	-15	mm w.c.
Effective flue gas flow	200.000	Em³/h
Standard flue gas density	1.31	Kg/Nm³
Flue gas temperature	about 1000	℃
Combustion chamber max. temperature	1350	℃
Drying burner thermal capacity	300000	Kcal/h
Pre-heating burner thermal capacity	5500000	Kcal/h
Combustion air fan flow No.1 (on burner)	17.000	Nm³/h
Combustion air fan delivery head No.1	220	mm w.c.
Combustion air fan flow No.2	18000	Nm³/h
Combustion air fan delivery head No.2	350	mmw.c.
Furnace rotary velocity	0 ÷ 2	rpm
Without ashes wires extraction flow (20% weight)	about 400	kg/h
Wires weight/volume	1500	kg/m³
Ashes extraction flow (2% weight)	0.2	m³/h
Ashes weight/volume	300	kg/m³

Afterburner

Natural gas burner capacity	2500000	kcal/h
Flue gas inlet temperature	>950	℃
Flue gas outlet temperature	980 ±30	℃
Flue gas velocity	>10	m/s
Contact time	>2	seconds

HRSG

Flue gas inlet temperature	980 ±30	℃
Economiser flue gas outlet temperature	170	℃ min.
Steam production	16	t/h
Superheated steam temperature	435±5	℃
Operation superheated steam pressure	45	Bar a
Design superheated steam pressure	54	Bar a
Feeding water temperature	110	℃
Flue gas side load losses (clean /dirty)	30/ 150	mbar

Turboalternator

Steam inlet temperature	430	℃
Steam inlet pressure	42	bar a
Gross electric power	3.300	kW
Voltage and frequency	6000 - 50	V - Hz

Main condenser

Flow of steam to be condensed	about 13 t/h
Condenser pressure (about 33℃)	0.07 Bar

Auxiliary condenser

Flow of steam to be condensed	about 21 t/h
Condenser pressure	Atm (+0.2 bar)

Flue gas extraction system and desulphuration

Negative pressure to be maintained at boiler outlet (Eco)	200 mm w.c.
Flue gas inlet	170 ℃
Stack outlet flue gas temperature	about 160 ℃
Master fan flow	75000 Em³/h
Master fan total pressure	2240 Pa
Secondary fan flow	78000 Em³/h
Secondary fan total pressure	3770 Pa

Guaranteed emission value and analysis method

	Description	DM 503 19.11.97 (Dir. 89/369/CEE e 89/429/CEE)	Directive 2000/76/CE (from 28.12.2005)	(1)
1	Carbon monoxide	50 mg/m^3 average day 100 mg/m^3 average hour	50 average day 100 average semi h	c
2	dusts	10 mg/m^3 average d 30 mg/m^3 average h	10 average day 30 average semi h	c
3	Organic substances	10 mg/m^3 average d 20 mg/m^3 average h	10 average day 20 average semi h	c
4	Hydrochloric acid	20 mg/m^3 average d 40 mg/m^3 average h	10 average day 60 average semi h	c
5	Fluoridric acid	1 mg/m^3 average d 4 mg/m^3 average h	1 average day 4 average semi h	c
6	SO2	100 mg/m^3 average d 200 mg/m^3 average h	50 average day 200 average semi h	c
7	NO2	200 mg/m^3 average d 400 mg/m^3 average h	200 average day 400 average semi h	c
8	Cd + Tl	0.05 mg/m^3 average h	0,05 average h	p
9a	Hg	0.05 mg/m^3 average h	0,05 average h	p
10	Sb+As+Pb+Cr+Co+Cu+Mn+ Ni+V+Sn	0.5 mg/m^3 average sum h	0.05 mg/m^3 average sum h	p
11	PCDD + PCDF	0.0000001 mg/m^3 average 8h	0.0000001 mg/m^3 average 8h	p
12	IPA (idroc. pol. arom.)	0.01 mg/m^3 average 8h	0.01 mg/m^3 average 8h	p
	Temperature	yes	yes	c
	Oxygen	yes	yes	c
	Volumetric flow	yes	yes	c
	Pressure	yes	yes	c
	Amount of water steam	yes	yes	c

(1) C = continuous registration
P = periodical registration

Demi plant

Average exercise integration	5 m³/h
Water quality (with mixed bed column)	0.1 μS/cm

Cooling tower

Heat to be used	7.000.000 Kcal/h
Cooling water flow	1000 m³/h
Inlet water T (nominal)	36 °C
Outlet water T (nominal)	28 °C
w.b. ambient T (nominal)	24 l °C

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Attachment 2

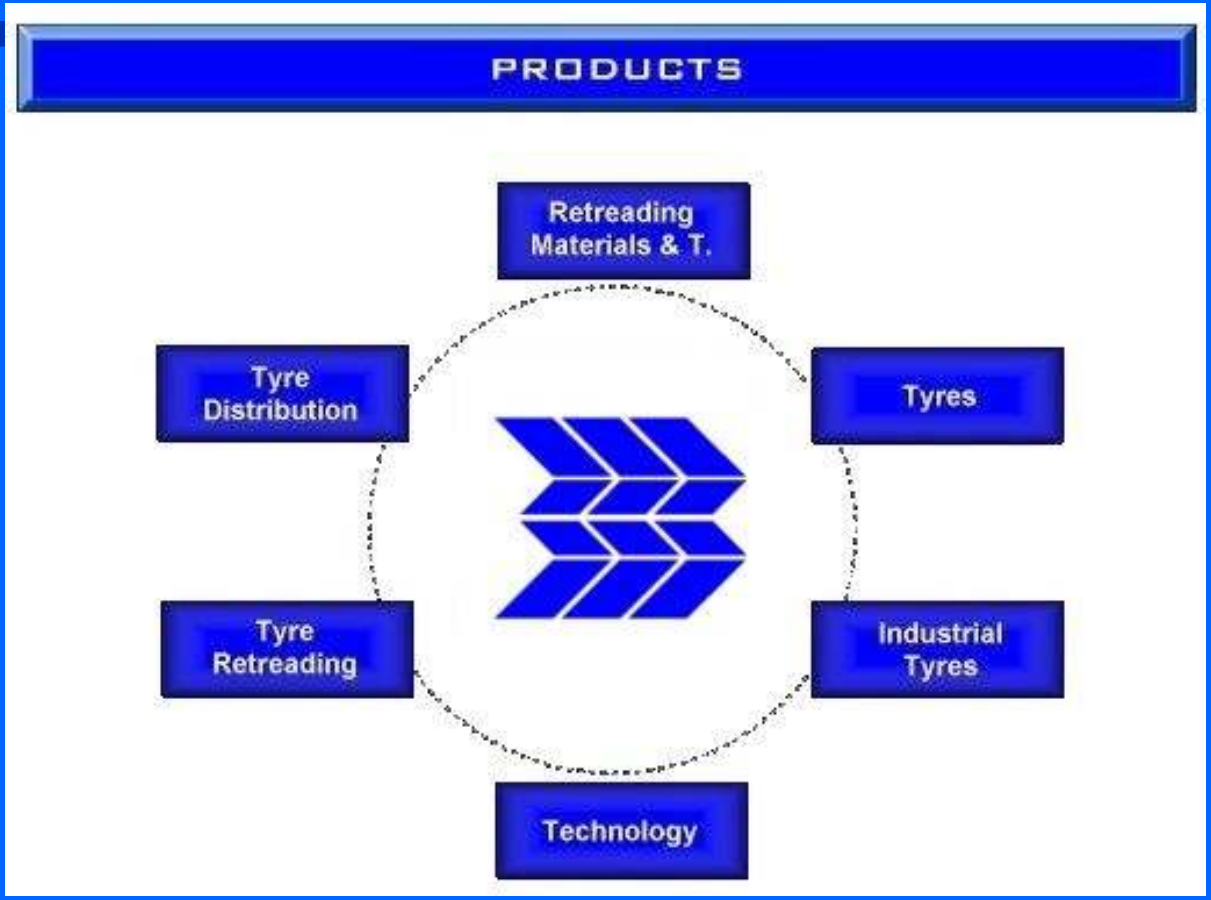
MARANGONI™
tyre machinery

Tyre to energy plant

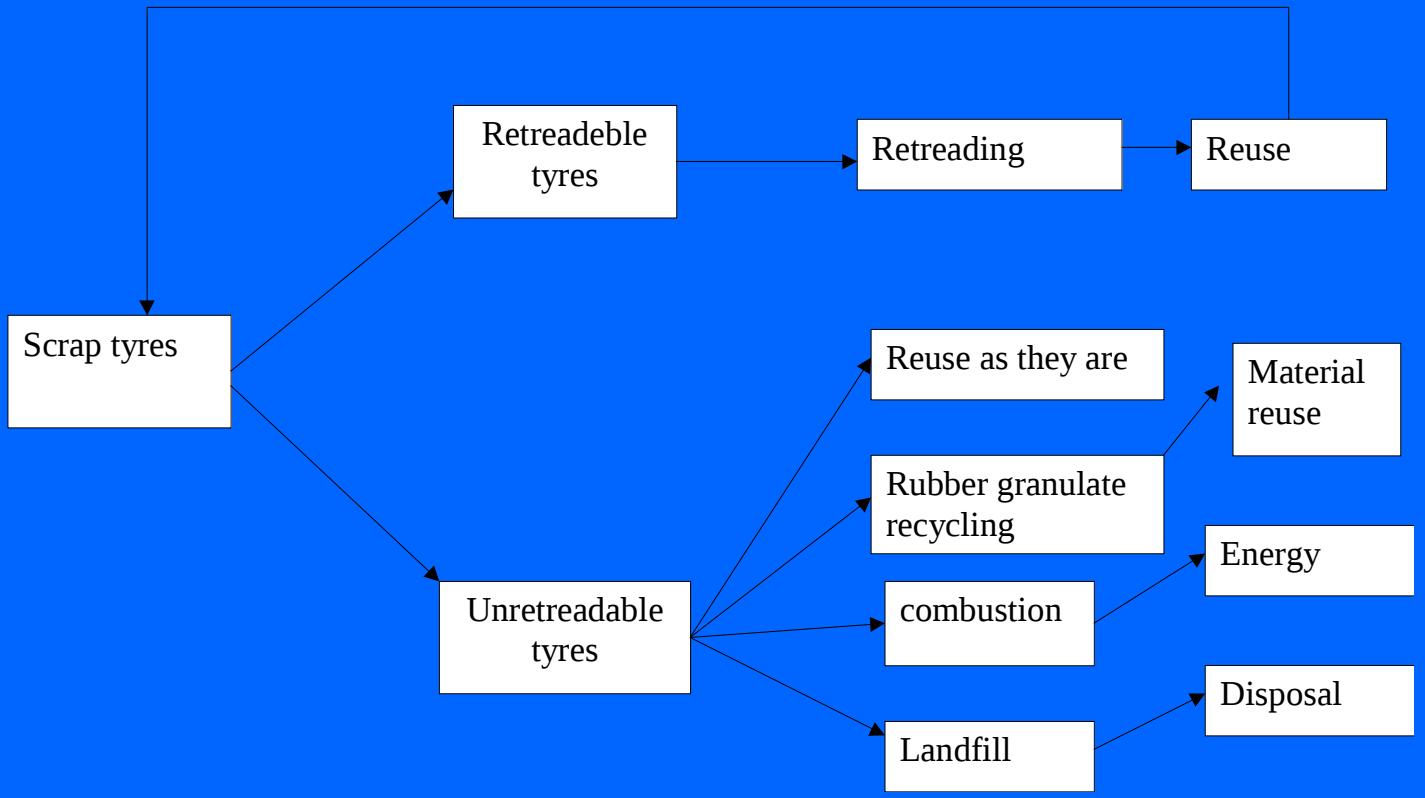
“Recycling and Energy”

“The 3rd Tyre Life”

Gruppo Marangoni



Scrap tyres cycle



Composition and calorific value (Scrap tyres)

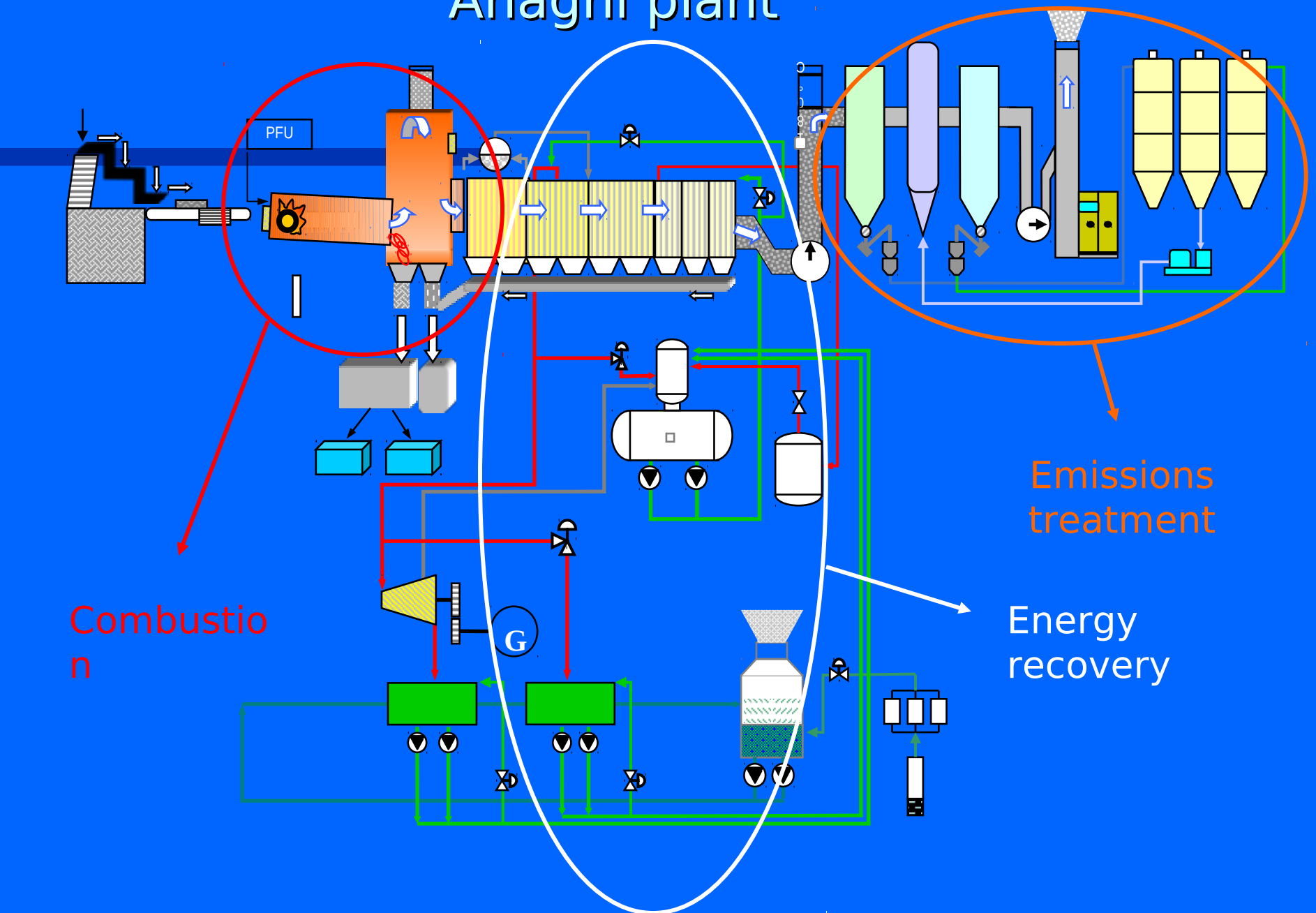
	CAR TYRES (% weight)	TRUCK TYRES (% weight)
Carbon	75 – 76	62 – 66
Hydrogen	6 - 7	5 – 6
Sulphur	1 – 2	1 – 2
Nitrogen	0,1 – 0,2	0,1 – 0,2
Iron	10 – 12	26 – 30
Zinc	1 – 1,2	2 – 2,5
Inert powder	3 – 4	3 – 4
Calorific power	5.500 – 6.000 kcal/kg	5.300 – 5.800 kcal/kg
Average weight	6,6 kg	60 kg

Annual Used Tyre Accumulation by EU State

Country	Used tyres per year	Population
Austria	41.000 t	8.045.800
Belgium	70.000 t	10.143.000
Denmark	38.500 t	5.251.600
Finland	30.000 t	5.116.000
France	380.000 t	58.265.400
Germany	650.000 t	81.845.000
Greece	58.500 t	10.474.600
Ireland	7.640 t	3.591.200
Italy	360.000 t	57.330.500
Luxembourg	2.000 t	412.800
Netherlands	65.000 t	15.492.800
Portugal	45.000 t	9.920.800
Spain	330.000 t	39.241.900
Sweden	65.000 t	8.737.500
UK	400.000 t	58.684.000
Total EU	**2.542.640 t**	**372.6662.100**

FONTE: ETRA

Anagni plant



Plant Charachteristics

WHOLE tyres combustion

ALL by-products recycling

Emissions in accordance with the European laws

Technology ...

... and people

Main technological issues

- Material study (refractories, filtering bags, belts)
- Steam generator cleaning system
- Tyres automatic feeding system
- Combustion control
- Pollution control

EMISSIONS VALUES

	Description	DM 503 19.11.97 (Dir. 89/369/CEE e 89/429/CEE)	Directive 2000/76/CE (limiti dal 28.12.2005)	(1)
1	Carbon monoxide	50 mg/m^3 average day 100 mg/m^3 average hour	50 average day 100 average semi h	c
2	dusts	10 mg/m^3 average d 30 mg/m^3 average h	10 average day 30 average semi h	c
3	Organic substances	10 mg/m^3 average d 20 mg/m^3 average h	10 average day 20 average semi h	c
4	Hydrochloric acid	20 mg/m^3 average d 40 mg/m^3 average h	10 average day 60 average semi h	c
5	Fluoridric acid	1 mg/m^3 average d 4 mg/m^3 average h	1 average day 4 average semi h	c
6	SO2	100 mg/m^3 average d 200 mg/m^3 average h	50 average day 200 average semi h	c
7	NO2	200 mg/m^3 average d 400 mg/m^3 average h	200 average day 400 average semi h	c
8	Cd + Tl	0.05 mg/m^3 average h	0,05 average h	p
9a	Hg	0.05 mg/m^3 average h	0,05 average h	p
10	Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V+Sn	0.5 mg/m^3 average sum h	0.05 mg/m^3 average sum h	p
11	PCDD + PCDF	0.0000001 mg/m^3 average 8h	0.0000001 mg/m^3 average 8h	p
12	IPA (idroc. pol. arom.)	0.01 mg/m^3 average 8h	0.01 mg/m^3 average 8h	p

N.B.:

- All value are referred to an oxygen concentration of 11% in the flue gas
- PCDD and PCDF are policlorodibenzodioxin and policlorodibenzofuran
- "c" is continuos monitorng, "p" is periodical monitoring

Hourly flows

INPUT:

2.000 kg		WHOLE scrap tyres
180	kg	Sodium bicarbonate
20	ton	industrial water

Selfconsumption: 500 kWh

OUTPUT:

2.800 kWh		(3.300 kWh gross)
400	kg	steel skeins
50	kg	zinc rich ashes
140	kg	sodium sulphate
to the landfill	40 kg	ashes

N.B: operating time: 7.700 h/year

ENERGY PRODUCTION

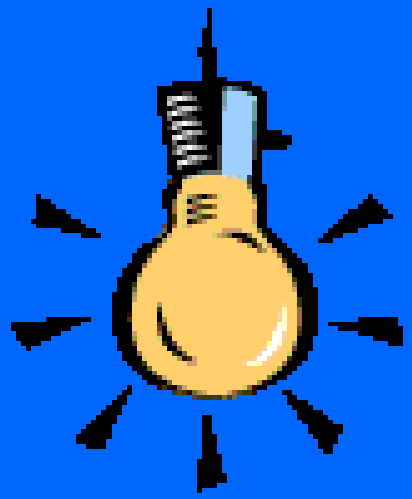
1 kg of scrap tyres → 1,4 kWh

1 car tyre → 10 kWh

A 60 W bulb for 2 for 166 h

1 truck tyre → 84

A 60 W bulb for 2 months



Main economical values (per year)

- Budgetary cost (civil work excluded) : 20 milioni Euro
- Net energy production 21.000.000 kWh
- Scrap tyres disposed: 15.000 ton
- Personell: 15 people
- Maintenance cost: about 2.5% of the plant cost
- Other costs: bottom ashes disposal

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Attachment 3

Worn tyres: a second life

innovazione ed ecologia

Worn tyres: a second life

Index

1. Analysis of the state of the art

1.1 State of the art: general information

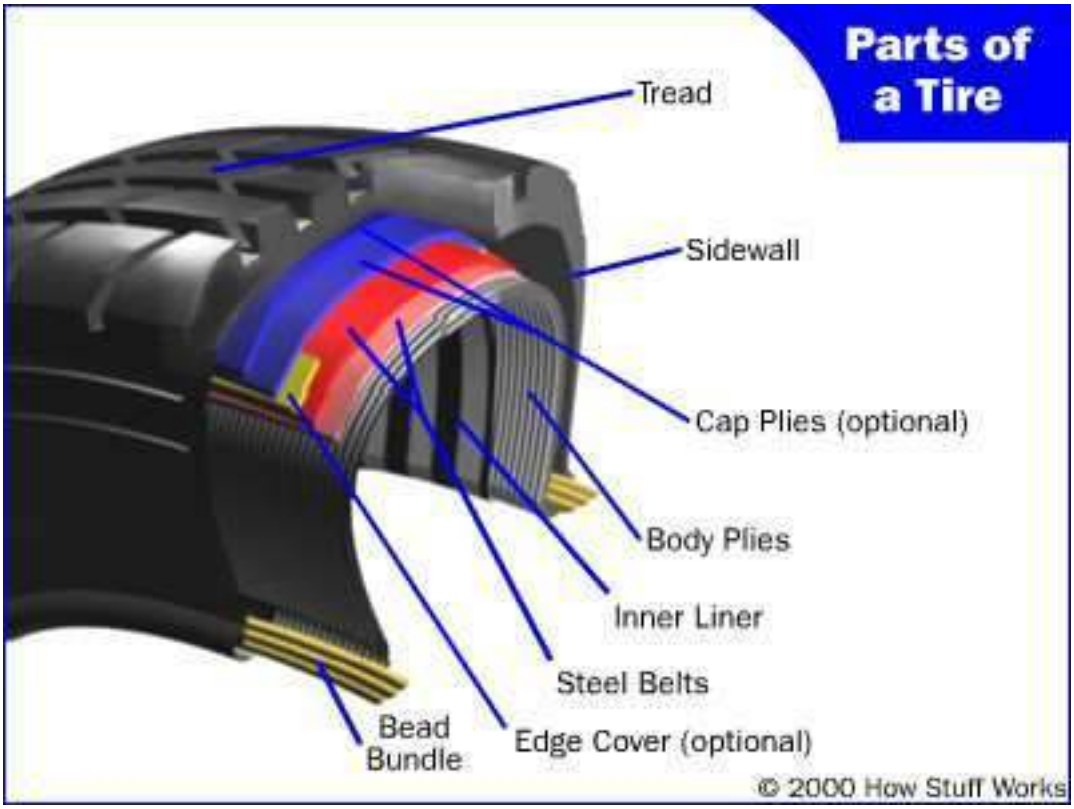
The composition and general properties of new tyres determine the treatment which can be applied to the tyre at the end of its on-road life cycle, and the possible applications of the products thus obtained. However, we should remember that the types of recycling and treatment do not only depend on technical factors, but also on national policies, and likewise on the economy and on the potential market for the recovered products.

The intrinsic characteristics of tyres determine: its use as a conventional fuel (its calorific power varies from 6.800 - 7.800 Kcal/kg); the recovery of excellent quality rubber in the form of crumbs and dust (secondary raw material); the recovery of steel.

The composition of car tyres differs from that of truck tyres. These differences exist not only in terms of dimensions, of steel or textile included in their structure, but also in terms of the types and proportions of the ingredients used in the basic mixes. In particular, these proportions are obtained from the ratio between natural and synthetic rubber, and also from the type of carbon black or silicon required to obtain the different properties of the tyre.

Tyres have good resistance to the traumas incurred when a vehicle is being driven, and are designed for longest possible life. As a result, one of their characteristics is the high resistance to the action of micro-organisms, which take more than a 100 years to destroy tyres. Although, on one hand, these properties enable the tyre to prolong its life cycle, on the other hand, they cause negative feedback when the tyre becomes a waste object.

The structural composition of a tyre consists of the following elements shown in the figure in summarised form.



The different types of tyre can be united in two main categories: the car sector and the truck sector. A specific distinction can be made in regard to the weight of individual tyres, if they belong to another category.

The composition for the two sectors - cars and trucks - is mainly determined by natural and synthetic rubber, the elastomeric component of which consists of the Styrene-Butadiene (SBR) copolymer.

Each ingredient of the mix (rubber/elastomers/ carbon black, steel, textile, zinc oxide, sulphur and chemical additives) contributes to give the tyre its specific characteristics, in order to benefit longer life.

An untreated rubber is relatively weak, soft, very flexible, and not soluble in water, alkalis, and weak acids, whereas it is soluble in benzene, diesel oil, chlorinated hydrocarbons, and in carbon-sulphur compounds.

To give the characteristics of strength and elasticity to raw rubber, it must be submitted to processes which generates links between the molecules that compose it. These processes are defined as vulcanisation.

When vulcanised, rubber becomes resistant to abrasions, and impermeable to gasses, chemical actions, heat and electricity.

1.2 Treatment of worn tyres

Below, we shall summarise the main technical characteristics of tyres for vehicles and worn tyres (for the sake of brevity, hereafter referred to as WT).

As we said, the composition of car tyres is different from that of truck tyres. Two tables shown below indicate the weight and composition differences between different types of tyres:

Weight of tyres		
Type of vehicle	weight in kg	No. of tyres/t
Car	07/11	90/150
Truck	50	20
Semi-trailer	55/80	10/18
Agricultural machine	100	10

Composition		
Material	Car	Truck
Rubber/elastomers	48%	43%
Carbon black	22%	21%
Steel	15%	27%
Textile	5%	-
Zinc oxide	1%	2%
Sulphur	1%	1%

The rubber most frequently used for car tyres, is the styrene-butadiene copolymer.

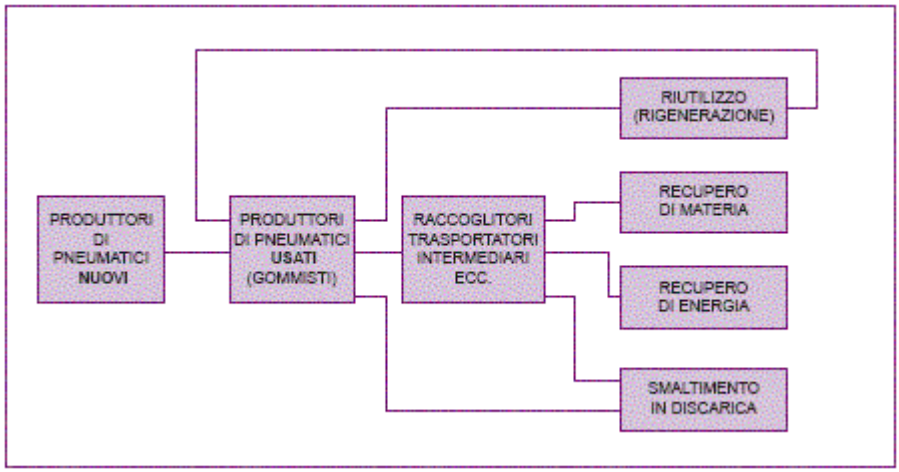
1.3 Chemical analysis of worn tyres (car type)

A tyre (car type) was chemically analysed in order to define its components. The table shows the results of these analyses.

element/alloy	content	unit
carbon	70	%
iron	16	%
hydrogen	7	%
oxygen	4	%
zinc oxide	1	%
sulphur	1	%
nitrogen	0.5	%
stearic acid	0.3	%
halogens	0.1	%
copper alloys	200	mg/Kg
cadmium	10	mg/Kg
chrome	90	mg/Kg
nickel	80	mg/Kg
lead	50	mg/Kg

1.4 WT Cycle

The cycle of the WTs is described in Figure 2, from the producer (mainly the tyre dealer who removes the worn tyres) to the final destination.



The worn tyre cycle

Granulation

The recovery of material is the most important phase in exploiting the worn tyre. This can be done by granulation, which is the basis of numerous recycling projects, and one of the systems for reducing the quantity of rubber waste, allowing re-use of a wide variety of polymers. Recycled rubber is in the form of crumbs or regenerated products which can be used, wholly or in part, as substitutes of virgin mixes. Treatment for the recovery of energy is a further phase in exploiting tyres. Fuel derived from tyres can be used in various ways: production of electrical energy, combustion in cement industries, in the paper industry, in metallurgy, in addition to the different types of pyrolysis. Energetic recovery is an important element in the process of reducing the quantity of worn tyres.

2 Shredding of WTs

In all the fields of application mentioned above, the products made - using granulated material obtained from shredding of worn tyres - enhance their technical characteristics if they are produced with a granule with well defined morphological and geometric characteristics. To produce excellent crumbs, a system designed and tested for this purpose must be used.

The shredding system produced by INNECO SRL was submitted for in-depth analysis, after which all the modifications to be made to ensure that the granule had the

characteristics recommended above, were defined. The analysis was carried out taking into account also the production aspect, i.e. by making modifications that enable an increase in production volume, without allowing the quality of the produced granule to fall.

2.1 The productivity advantages of the INNECO shredding system

After various tests, we came to the conclusion that an in-line system such as the tyre shredding system, had to guarantee operational flexibility sufficient to ensure better management, and consequently, an increase in production. Our conclusion entailed building an 'island' system, i.e. a system where the production phases are able to operate independently, in order to optimise energy consumption, maintenance jobs, and personnel management. As can be seen in more detail in the offer, the system is split into 4 macro-phases:

Bead breaking phase: at this phase, truck tyres only are de-beaded: i.e. the metal ring fitted in the bead is removed by a bead breaking machine;

Bead breaking machine

Shredding phase: at this phase, car and truck tyres are loaded on the belt feeding the shredding machine and are triturated in the operating machine named "shredder".

Shredder

A screening phase, using a rotating screen follows outfeed from the shredder:

Screen

The screening is aimed at obtaining pieces of about 120 x 120 mm. Triturated material which fails correct screening (dimensions of over 120 mm), is sent back for further piece reduction.

Granulation phase: at this phase, material received from the preceding shredding phase, is reduced into rubber crumbs with a diameter from 0 to 15 mm, by means of an

operating machine named "granulator". As the productivity of the shredder is almost double that of the granulator, we are providing a double granulator to avoid any reduction of production volume.

The granulation phase

Metal remover

At this phase, the metal part is also eliminated by a "metal remover", i.e. a magnetic separator which separates by conveying the iron on a conveyor belt and taking it outside for storage in a bin.

After separation, the granulated material is sent by a pneumatic system, to the next phase, grinding.

Grinding phase: at this phase, the material ranging from 0 to 15 mm, received from the granulation phase, is ground to obtain rubber crumbs and dust, with pieces in the range of 0 to 4 mm. The operating machine used for this is the "blade mill".

Blade mill

At this phase, the textile part is also separated in two steps:

- by using a TIERED SCREEN. This screen consists of six tiers with a perforated surface, to allow the granulated material received from grinding, to descend into the collection bin, from where it is then conveyed to the lifting screw. The size of the holes on the tiers is sufficient not to allow the fabric to transit. Due to the vibrations, the fabric tends to accumulate, and by exploiting the slope of the screen, it is unloaded onto the conveyor belt and stored outside in the bin

Tiered screen

- by using 'taring devices' equipped with a suction unit on the upper part. By exploiting gravity and the different weights of the two components (rubber and fabric), and through the use of suction, the fabric part can be taken away and is conveyed outside, whereas the rubber part drops into the relevant big-bags.

Taring devices

Each of the above mentioned phases is independent of the others, so that, if one is idle for maintenance, work can continue on the others. At this point the following question naturally comes to mind: but is it possible to make the system operate in line, that is to say, with a succession of phases in automatic mode? The answer is yes. In fact, with the exception of the bead breaking phase, which always operates independently, measures were studied for the successive phases, to make the system automatic. A reversible belt was installed between the shredding and granulation phases. This belt conveys the triturated material (with maximum piece size of 120 x 120 mm) at the outfeed point of the screening operation, toward the granulator infeed slat conveyor belt. The granulator infeed belt is equipped with laser signalling devices, which measure the volume of transported material.

When the volume reaches the appropriately set reference value, the PLC changes the rotation direction of the reversible belt, thus conveying the triturated material into a box outside. This quantity of material acts as a reserve for the triturated material to be used when the customer wishes to halt the shredding phase. As soon as the volume drops

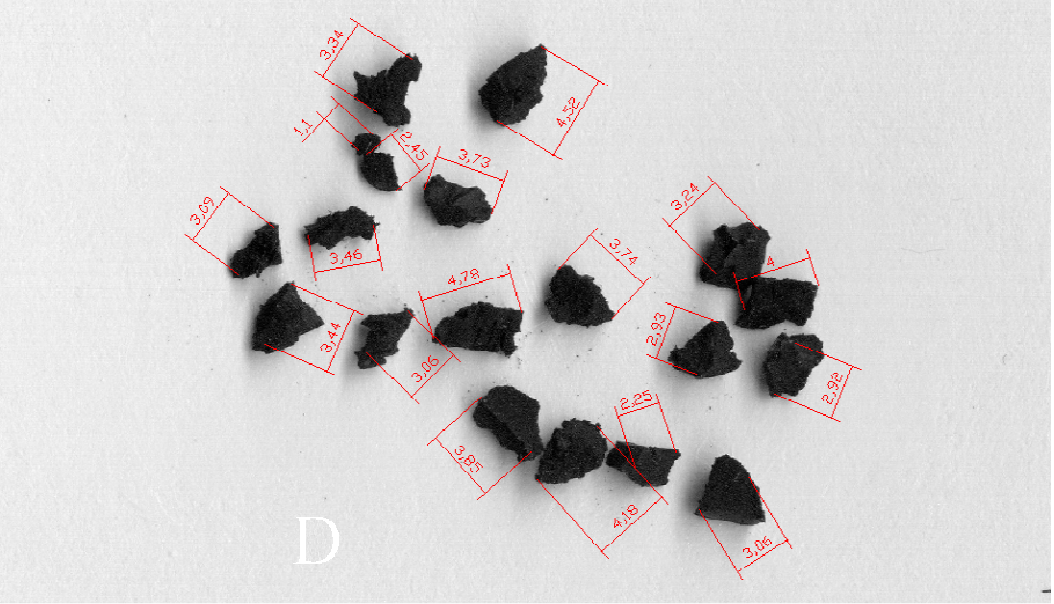
below the set value, the PLC once again changes the rotation direction of the reversible belt, thus feeding the loading belt of the granulator.

Reversible conveyor belt

We have inserted a reversible screw between the granulation and grinding phases. It is controlled by a maximum level probe installed in the loading hopper. By rotating in one direction, the screw feeds the loading hopper of the blade mill (in-line operation), and, by rotating in the other direction, it fills the storage big-bags (independent operation).

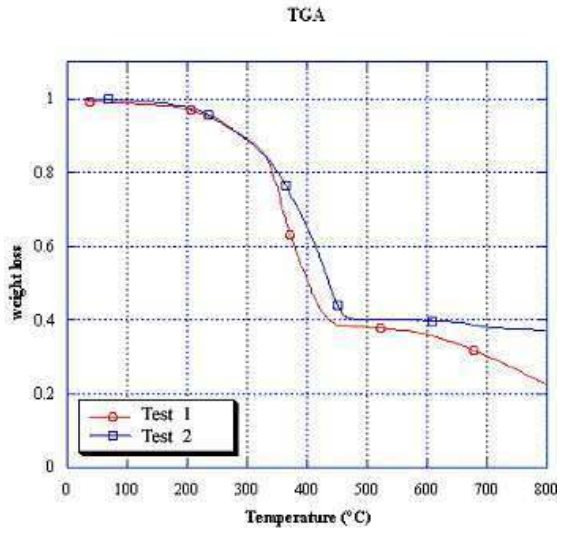
2.2 The advantages of the INNECO shredding system for the quality of the granulated material

According to tests carried out on crumbs with different types of morphology, it can be evinced that the best results are obtained with granulated material of spherical shape. During the moulding phase, they crumbs offer better compression, while conferring significant technical characteristics to the pressed article.



Granule with dimensions of 2--4 mm

One of the parameters strategic to obtaining high quality granulated material is the operating temperature, as evinced from the thermal tests run on the granulated material in the laboratories of the Department of Engineering of Materials and production at the Federico II University of Naples:



It can be noted from the trend of the curves that, already at a temperature of about 200°C, the degradation process of the material begins, corresponding to a significant loss of weight: as a result, in order to use such materials, controls are necessary to ensure that the temperature is below this value.

High temperature during the phases when the tyre is reduced to crumbs creates a negative impression of both the product and the system.

The vulcanised granule loses its elasticity due to the change of its outer surface, its shape becomes irregular and fringed due both to the greater wear of the cutting tools which are more easily blunted, and to the greater plasticity of the material, which tends to tear rather than be cleanly cut. There is also a greater production of dust, i.e. the produced crumbs have shapes that vary extremely from each other, (wide granulometric curve) due to greater friction and rubbing.

Moreover, the high temperature hinders the detachment of the fabric and steel from the tyre with obvious consequences on the quality and purity of the obtained product and on its commercial value, if put directly on the market.

As concerns the system, in addition to the excessive wear of cutting tools, granulators and pulverisers we had mentioned, and, in general, all surfaces coming into contact with the product, high temperatures favour the clogging of the machines and the pneumatic transport ducts, due to the greater tendency of the dust and crumbs to adhere; this leads to dangerous negative effects on the fire-prevention safety of the entire system, as well as lower productivity, caused the necessary machine down-times for extraordinary cleaning and maintenance operations.

The screening phase too is affected, more or less indirectly by the effect of granule compression and the excessive tendency of the crumbs to cohere when the product is hot.

Keeping temperature under control therefore means: intervening at the design phase on all the plant's components, with more efficient air and/or water cooling systems; adopting materials with low thermal inertia, components with shapes and profiles with a large thermal exchange area; undertake in-depth studies on shapes, materials, and on the treatments of cutting tools, on their optimal coupling with the material to be reduced (in order to obtain crumbs with uniform, constant and repeatable dimensions and shape), on the route for outfeeding the granulated product in the machines - this route must also benefit from efficient mechanical and pneumatic ventilation.

Dust removal efficiency must be optimised (by its very nature, dust tends to clog, create friction and heat between bodies in relative motion), by means of a more adequate collection, extraction and separation system.

In the old systems (almost all those now in operation), many of the problems linked to process parameters are not solved, with negative effects on the quality of the obtained product, on its uniformity and reproducibility, on production costs and on the safety of the system.

The system proposed by INNECO SRL is the result of intense innovative research in materials, machines, and products and involves all sectors, from design through to the production of the machines and of the entire system and its maintenance to avoid the inconveniences and limits typical of the systems currently in use.

2.3 Execution of tests

We shall now list some modifications to the cutting elements, studied to improve the quality of the produced granulated material.

2.3.1 Tests executed on the shredder

We ran the tests to verify if the shredder - one of the system's essential operating machines - operated correctly. The tests were carried out for the sole purpose of determining the dimensions, position and quantity of blades to guarantee a high quality triturated product.

The set of blades consists of :

- Blades, thickness 50 mm, multi-beak (No. 4 beaks);
- Blades, thickness 60 mm, one beak only;
- Blades, thickness 100 mm, one beak only.

The blades were installed on the shredder's two shafts in the following way::

A. 50 mm blades at the centre, then the 60 mm blades, and finally the 100 mm blades (i.e. increasing outward);
B. 100 mm blades at the centre, then the 60 mm blades, and finally the 50 mm blades (i.e. reducing outward);
C. 60 mm blades at the centre, then the 50 mm blades, and finally the 100 mm blades
D. All 100 mm.blades.

A) 50 mm blades at the centre, then the 60 mm blades, and finally the 100 mm blades

For the first set of tests for the set-up of the primary shredder, the 50 mm multi-beak blades were placed at the centre, followed by the 60 mm blades and then by the 100 m blades. With this blade configuration and geometry, we noted a good output, 2.7 t/h, and small pieces - in fact the dimensions of the triturated material were about 70-350 mm.

With this piece size, one could even consider skipping the screening operation, carried out with the rotating screen, thus cutting down on production time. In spite of the good results, we had to reject this blade lay-out, because the hydraulic power-pack of the shredder was over-stressed, thus seriously compromising the reliability of the shredding process, and submitting the shredder to failure risks.

B) *100 mm blades at the centre, then the 60 mm blades, and finally the 50 mm blades*

Contrary to what we did in the first set of tests, we placed the 100 mm blades at the centre, then the 60 mm blades, and finally the 50 mm blades.

With this blade lay-out, we obtained a piece size which we can define as medium - large 90 - 400 mm, which does not enable us to exclude a subsequent screening operation, and quite good output 2.9 t/h.

However we encountered problems in this case too:

- The hydraulic power-pack is not all stressed at the beginning, but after some work cycles, stress increased quickly, reaching values that put the safety of the machine at risk;

- With this blade lay-out we noted that the material to be triturated in the grinding chamber, tends to shift outward, forming accumulations on the machine's shaft lateral shift bearings. As steel was still present in the triturated material, the seals were irreparably damaged, and had to be replaced. As a precaution, we also replaced the bearing cones, as they had shifted to the outside.

C) 60 mm blades at the centre, then the 50 mm blades, and finally the 100 mm blades

This time we placed the 60 mm blades at the centre, then the 50 mm blades, and finally the 100 mm blades. With this blade lay-out, we obtained a small piece size of 70-250 mm, which enables us to exclude a subsequent screening operation, but output was very low at 2.3 t/h.

The hydraulic power-pack underwent considerable stress.

D) All 100 mm blades.

Lastly, we placed all blades with a thickness of 100 mm.

Well, with this lay-out, we obtained satisfactory results:

- The piece size of the triturated material is highly uniform (2 -50 cm);
- Stress to the hydraulic power-pack is below 40%;
- Energy absorption below 20%;
- Good output (3.5 t/h)

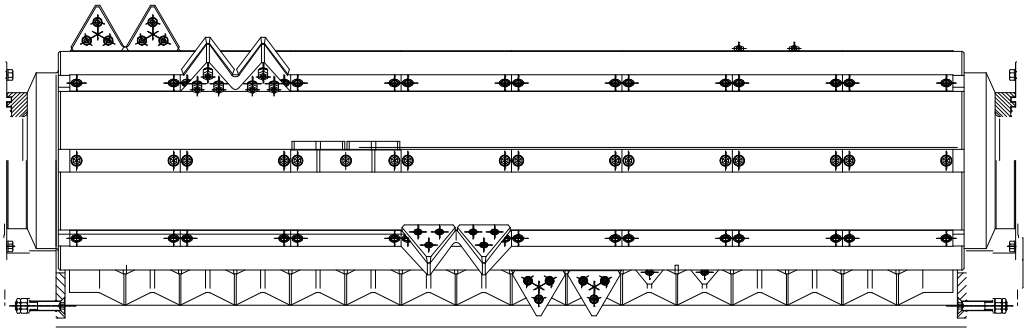
All 100 mm blades

With this blade lay-out, the screening operation on a rotating screen is necessary.

Triturated material

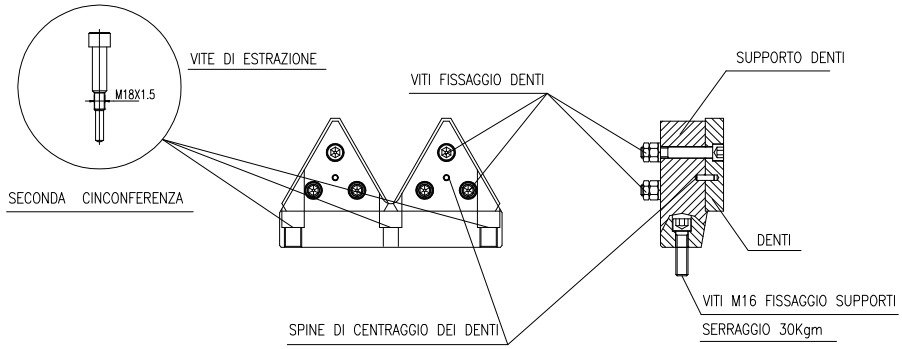
2.3.2 Tests executed on the granulator

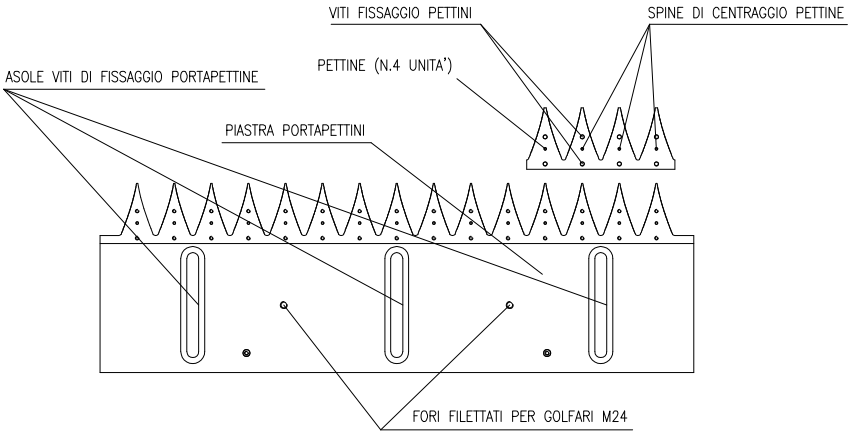
The granulator's feature is the special shape of the blades installed on the shaft:



Granulator shaft

Blades in K110 bolted on supports in C40





Details of the triangular blades and the 'comb' fitted on the fixed part

The triangular blades fitted on the granulator shaft, caused considerable problems during the experimentation phase of the granulator set-up.

As can be seen from the diagram, the triangular blades (teeth) produced in K110 are fixed via bolts to the supports produced in C40. After a few hours of operation, wear of the blades and of the relevant supports could be detected.

Worn granulator blades

To restore the supports, deposits in stellite were applied with an electric-arc welding machine, while the triangular blades were replaced. In this way, we restored the geometry of the blades and supports, but not that of the bolts securing the blades to the supports, thus putting at risk the safety of the entire operating machine. In fact, if a triangular blade were to detach, it could enter the grinding chamber, causing significant structural damage.

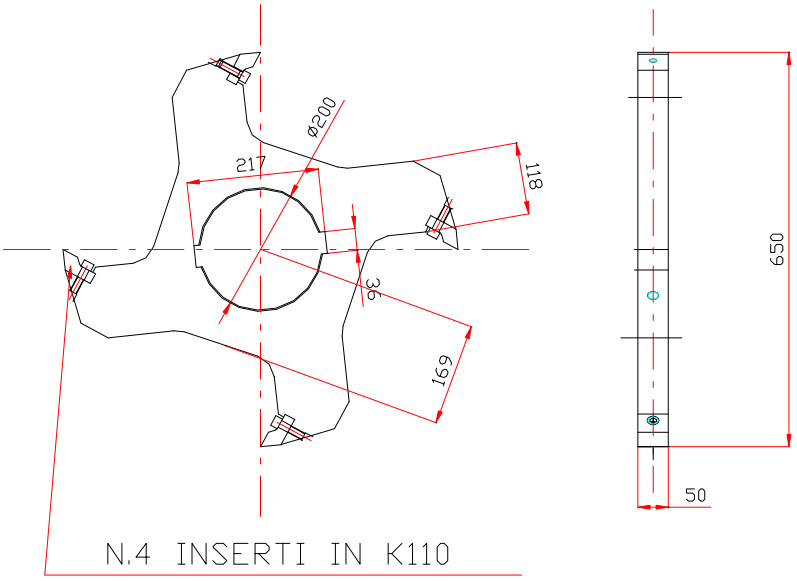
Therefore, to ensure safe conditions for ourselves, we would have had to replace the bolts. This would have led to enormous loss of time, and consequently, of output, as the machine down-times were very long.

To overcome this problem we thought of replacing the tooth-support combination with an integrated support, i.e. the blade and supports are a single body, as shown in the figure below.

Blades with integrated support

2.3.3 Tests executed on the blade mill.

Here too, as in the case of the granulator, the focal point of operation are the blades. The mill blades have the following geometry:



Mill blades

i.e. here, there are supports with four beaks, on which the K110 inserts are installed with bolts.

As the thickness is 50 mm, the number of blades installed on the shaft is 32.

Blades for the mill, with a thickness of 50 mm

In spite of the presence of the MR8 refrigerator, we noted, during the tests, that the temperature remained high during the grinding stage (T = 90° C). Having said that, we examined the possible effects of exposure to this temperature on the granulated material.

The analysis showed that the geometry of the granulated material seems much more tapered (needle-shaped), as shown in the figure below:

Needle-shaped crumbs

This goes against the wish to create granulated material with a spherical geometry.

Therefore, to keep the operating temperature low, making use of the experience of the manufacturer's technicians, we increased blade thickness, while reducing blade quantity.

With a thickness of 106 mm, the number of blades fitted on the shaft is 15.

Blade mill with relevant blade

After a second analysis of the product outfed from the blade mill, with this type of blade, we noted that the crumbs had a rounded shape, a sign that the correct blades had been chosen.

Spherical crumb produced with 72 mm blades

3 Moulding systems for articles in recycled rubber

All the work carried out for correct definition, installation, and operation of the tyre shredding system is aimed at obtaining granulated material that enhances the technical characteristics of articles produced with the system. There would be no sense in installing a shredding system with technologically advanced know-how, only for the production of granulated material.

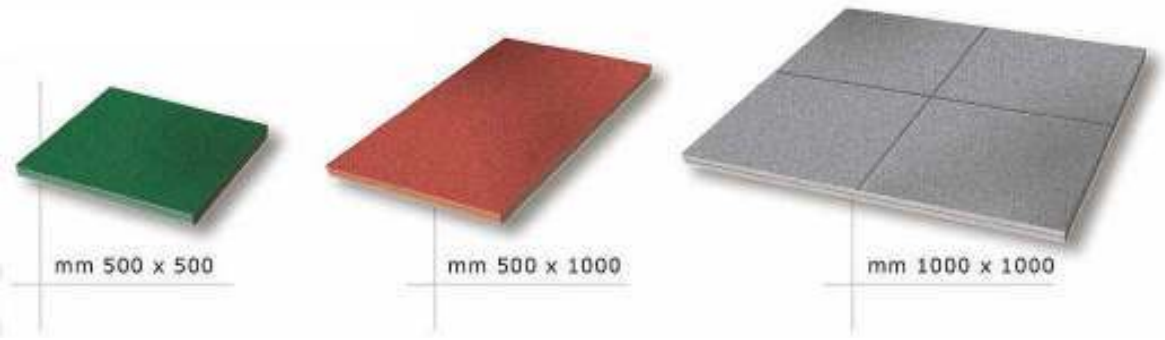
We shall now provide some examples of articles which can be obtained by using rubber crumbs.

3.1 Play areas

Many play areas in public parks contain materials recycled from tyre rubber, guaranteeing safety at low maintenance cost. It is recommended that they be installed, e.g. under swings and slides, where they cushion falls.

A whole range of new pavings has developed, starting from tyre granulation. Easy to install, non-slip, elastic, resistant to water, mould and traces of damp, these paving materials are used in swimming pools, in garden areas and in many other public and private applications. Available in a multiplicity of colours and shapes, they are an interesting alternative to cement and other rigid materials. They can often be installed on the ground, without any expensive preparation works.

ANTISHOCK materials for urban furnishing can eliminate the causes of accidents in outdoor areas where people habitually run, jump, play and walk.



It is recommended for play parks, golf courses, cycling tracks, recreation areas and private gardens. Entirely built with crumbs from recycled rubber, this is a top quality product, tested and approved, and conforming to the directives imposed by standard UNI EN 1177.(European regulations). A special characteristic of its structure is easy water drainage.

INNECO SRL has developed know-how for forming this special article. The procedure used is suitable for producing antishock tiles in various colours, with thickness in the range from 20 to 80 mm and dimensions of 500 x 500, 1000 x 500, 1000x1000 or 1500 x 1000 mm. The procedure is essentially mechanical and is executed in two processing phases:

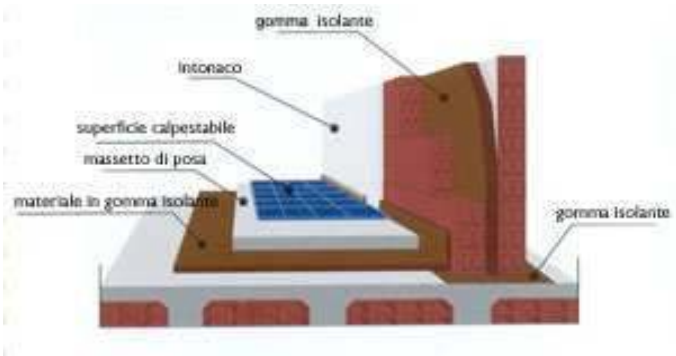
a) *Mixing phase:* The mixing phase is performed by a mixer which ensures perfect uniformity of the mix elements (crumb, binder and water) in a relatively short time, to guarantee a sufficiently high output.
b) *Moulding phase:* The moulding phase is split into three subphases:
    - Filling the mould;
    - Pressing;
    - Extraction.

The mix is placed inside the mould in the "loading station" and then, by means of a 'carousel' transport system, it is taken under the press for the pressing operation. When this operation has been completed, the mould is taken to the unloading station, where the moulded articles are extracted and placed on storage pallets.

3.2 Acoustic insulation

The rubber granulate received from the shredding of worn tyres, is widely used for forming sound insulation membranes. The sound insulation membranes are installed::

- *as sub-paving*: with the function of absorbing foot-traffic noise (vibration dampening);
- *as acoustic insulation elements*: they are placed in the interspace between walls in order to reduce the spread of sound to rooms adjoining the room from which they originate and spread.
-



Noise is one of the most widespread polluting agents, with which we are forced to interact day by day. The spread of sound waves is a problem that affects designers and creators of works destined for civil and industrial use.

The function of acoustic insulation products is to prevent the spread of sound energy to surrounding ambients.

The acoustic insulation membranes produced with our technology perform this very function. When laid under the pavements/floors and in between wall interspaces, they limit the spread of sounds, thus making the ambient/room where one lives or works, more peaceful and comfortable.

The membrane moulding system produced by INNECO SRL is the only continuous moulding system now on the market. Contrary to the other systems, it makes it possible to obtain membranes in a single step, without any further cutting or thickness reduction phases. This system was produced from an idea of INNECO SRL, which holds the relevant patent.

The procedure used enables production of acoustic insulation membranes with a width of 1000 mm and thickness values ranging from 3 mm to 15 mm. The procedure is essentially mechanical and is performed in the following phases:

a) *mixing phase:* The mixing phase is performed by a mixer which ensures perfect uniformity of the mix elements (crumb, binder and water) in a relatively short time, to guarantee a sufficiently high output.
b) *moulding phase:* The mixed material is uniformly distributed on a steel belt, using its entire width and is conveyed toward another steel belt above the first one, which rotates in the same direction. The belts are heated in order to provide the quantity of heat required for polymerising the mix. The distance between the two belts can be adjusted according to the thickness required for the final product.
c) *cutting and winding phase:* the phase consists of a cutter, which cuts the moulded membrane to an established size in metres, and of winder which rolls the moulded material on reels for subsequent storage.

Membrane moulding system

3.3 Anti-vibration mattresses

The anti-vibration mattresses are used for eliminating vibrations caused by the functioning of the operating machines (such as presses, screens, pumps etc.), in order to improve the quality of the work environment and protect the life of structures and installations. In fact, if the anti-vibration mattresses are placed under the operating machines, they absorb the vibrations caused by a given operation, without discharging them to the bases and, consequently, on both the floor of the production plant, and the adjoining structures. A very interesting application is the insulation of vibrations produced in the railway-tram sector, which prevents the irritating vibrations caused by the transit of locomotives to spread to the dwellings near the railway line.

The process to obtain these products is similar to that of the antishock tiles. Results show that acoustic pollution can be reduced by 40% and vibrations by 30%. The use of these products is particularly interesting in city centres.

3.4 Waterproofing elements

Instead, the waterproofing elements are used wherever there is need to protect surfaces against contact with liquid substances.

3.4.1Waterproofing membranes

The RENOPLAST-R waterproofing products consist of special mixes where the key element is rubber granulate obtained from the recycling of worn tyres. RENOPLAST-

R, in rolls, can be combined with different materials. Its combination with an adhesive film makes the product particularly practical for the installation of many applications. It is an ideal solution for roofs of industrial and civil buildings, providing a concrete solution to all waterproofing problems. Thanks to its technical characteristics - resistance to corrosive agents, resistance to UV rays, resistance to breakage, it can be used as a geomembrane.

3.4.2. Tiles

RENOPLAST-R products consist of special mixes where the key element is rubber granulate obtained from the recycling of worn tyres.
RENOPLAST tyles, produced in panels of various colours, can be applied in various fields, such as roofs for homes, sheds/lean-tos, gazebos,etc. Thanks to quick installation, very long-life, no maintenance and eco-compatibility (an entirely recyclable product), RENOPLAST is a very effective instrument for roofing any type of building.

INNECO SRL is willing to transfer the know-how required to obtain these products.

3.5 Future developments

INNECO SRL in co-operation with its historic partners in the search for new products and fields of application for articles in recycled rubber, i.e. the Department of Engineering of Materials and Production, and the Ferrara Research Consortium, is engaged in studies to determine the technologies for obtaining some products already

obtained by means of applications performed in the laboratories. The above mentioned products have already been tested, and provide broad guarantees in terms of both operation and technical characteristics.

3.6.1 Asphalts

When mixed in asphalt, the rubber crumbs obtained from worn tyres bestow greater porosity, which enables rainwater to drain from the surface, thus reducing stagnant water. This clearly improves adherence of tyres to the road surface, minimising the aqua-planing phenomenon (wet wheels slipping at high speed). This use also reduces the noise produced by the vehicle, and attenuates headlamp glare.

Sports surfaces

The paving of sports areas is generally obtained with the use of rubber crumbs from recycling of worn tyres. They are easy to install, low cost, and offer players the advantage of reducing the risk of injuries after falls. They have drainage properties which prevent water from stagnating, making the playing area usable in bad weather.

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Attachment 4

SOUTH EASTERN EUROPE

Company profile

COMPANY PROFILE

ASSECO SEE GROUP

The Group Asseco SEE is the largest operator in South-Eastern Europe in terms of revenue derived from sales of its software and services. The Group Asseco SEE came into being as a result of the integration of competence, experience, knowledge, solutions and customer base of the seven major, leading in their segments, companies operating in the region of Southeastern Europe and Turkey. Since the beginning, the Group Asseco SEE subsidiaries focused on developing their own solutions in their market segments.

Today, Asseco SEE Group operates mainly in the following five segments of the information market:

- solutions and services for the banking–sector,
- solutions in the area of the mobile banking & authentication
- supply, installation and integration services in the field of ATMs and payment terminals,
- solutions and services to the general business and telecommunication sector
- Integration services and delivery and implementation of ICT systems and equipment.

In November 2009, Asseco SEE has been listed on the Stock Exchange of Warsaw. From December 2010 Asseco SEE has more than 1,200 employees and runs its business operations in 12 countries.

Asseco SEE client's list is already confirmed with 10 out of 15 largest banks in South Eastern Europe:

- Allianz
- Commerzbank
- Deutsche Bank
- Erste
- Fortis
- Intesa
- KBC
- NLB
- PKO BP
- Rabobank
- Raiffeisen
- Societe Generale
- Unicredit
- VolksBank

ASSECO SEE IN ALBANIA AND KOSOVO - SOLUTION PORTFOLIO & LIST OF REFERENCES

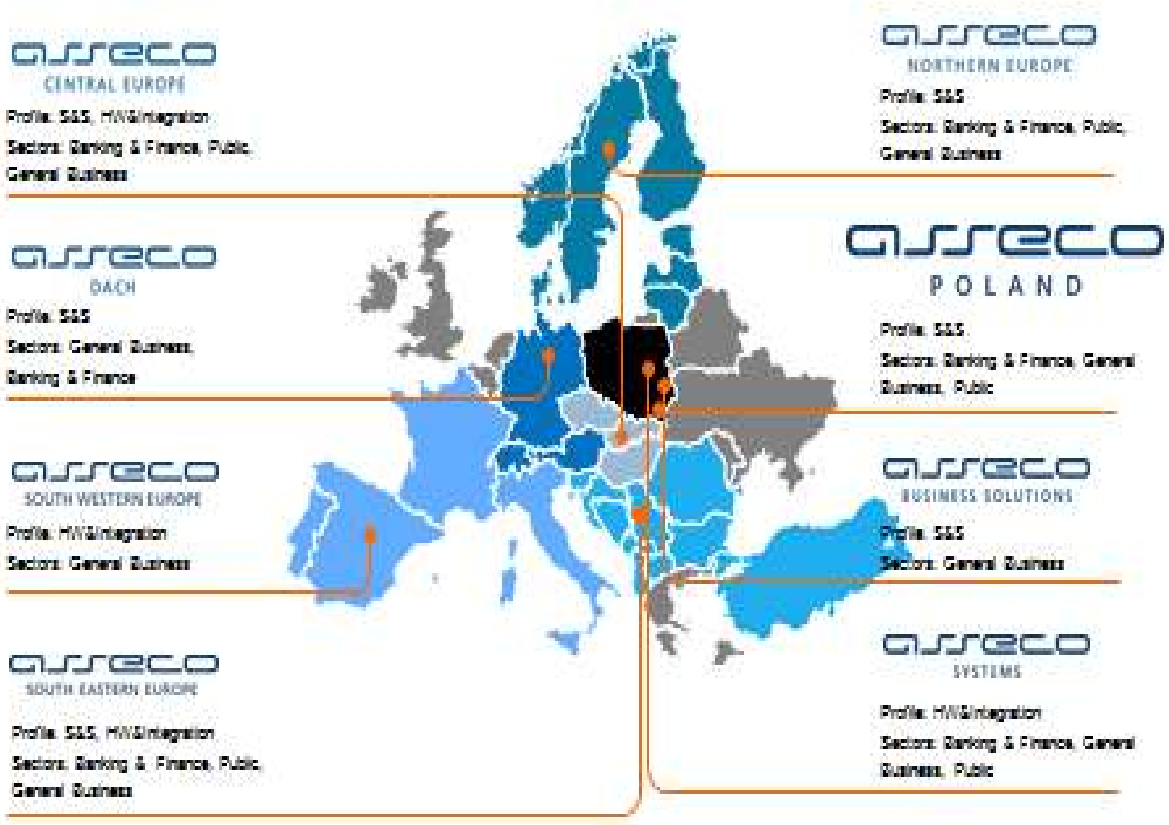
Our main clients are medium and larger business organizations coming from different market segments such as the Financial Services Industry, Government and Public Institutions, Network Service Providers and Retail Services Industry.
Since the beginning of operations and up to nowadays, we've managed to implement a large number of various IT projects which offer integrated information systems and software solutions, such as:

- for the Banking industry:
  - Inter-banking Clearing System, Statistical System, Credit Registry, Core Banking, SMS-banking, E-banking, Mobile banking, Card Management, CRM, AML reporting and analyzing, ATM and POS solution and services, etc.
- for the Judicial system:
  - Case Management Information System for Courts and Prosecutor, Offices, Information System for The Inspection Unit etc.
- for the Government institutions:
  - Integrated Boarder Management IS, Pensions System, Employment IS, etc.
- for Public Utilities:
  - Mass-Billing, Accounting, Inventory system, HR and Payroll, Time Attendance and Access Control etc.
- for the Retail services sector:
  - Enterprise Resource Planning, Warehouse Management, Supply Chain Management, Point-of-Sale solutions, etc.

Asseco SEE's solution portfolio is growing every day and its client base is widening also into other market sectors in Albania and Kosovo and in the region.

Below is a brief portfolio with a description of the solutions and/or services provided for a number of clients from various market sectors in Albania and Kosovo market:

ASSECO SEE IN EUROPE

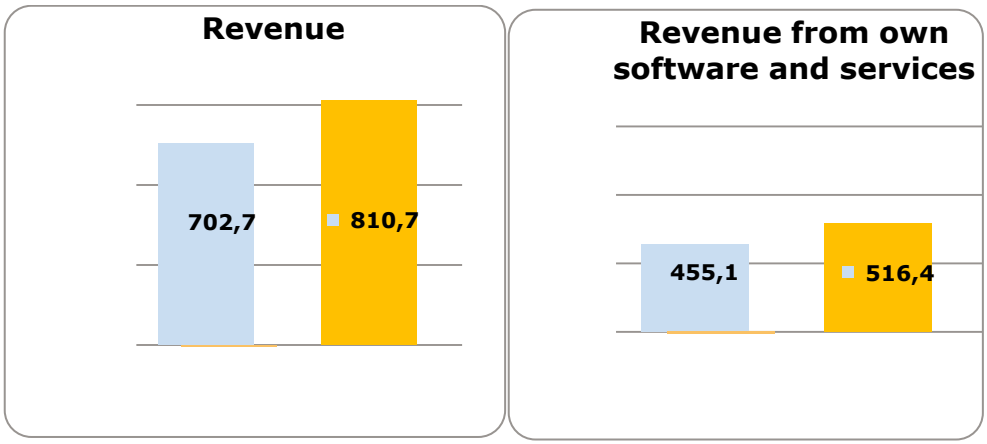


ASSECO SEE – SUBSIDARIES MANAGEMENT

- 12 countries
- 119m people
- 3 in EU rest with EU aspirations
- Software and competences have to be multilingual, multicurrency
- Strong focus on BSW

SOUTH EASTERN EUROPE

ASSECO GROUP – BASIC FINANCIAL FIGURES *Data in mEUR



ASSECO SEE– PARTNERSHIP WITH LEADING TECHNOLOGY VENDORS

Cisco Systems Gold Certified Partner

SAP Business Partner

Microsoft Gold Certified Partner

HP Gold Partner

IBM Business Partner

KOFAX

EMC Velocity Premier Solution Partner

Fujitsu Corporate Partner

Wincor-Nixdorf Business Partner

Thales Business Partner

Hypercom Business Partner

Vmware

Oracle Platinum Partner

Gemalto Business Partner

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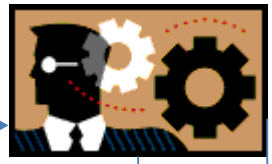
Attachment 5

SOUTH EASTERN EUROPE

RecityrePlus - Function Diagram

Function Diagram of the Processes for Project «RECITYRE*plus*»

Identification points Used tires
Tire-
-Retreaders
-Service Station
-Workshops
-Locations Fleet
-Conveyor
-Demolition of vehicles
-Shopping Centers



Assumption

Census of the Consignee (Plate, VAT ...)

Automobile Club, Ministry

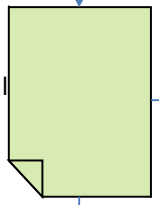
Consultation

Police control rooms; Police dept.

Common repository

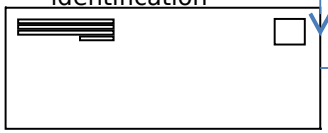
consultation

Compilation module for environmental contribution

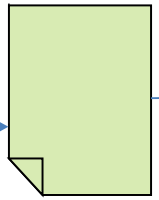


Automobile Club

Contact Ecotyre for disposal location identification

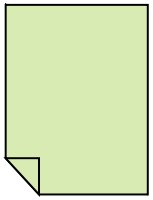


Form filling



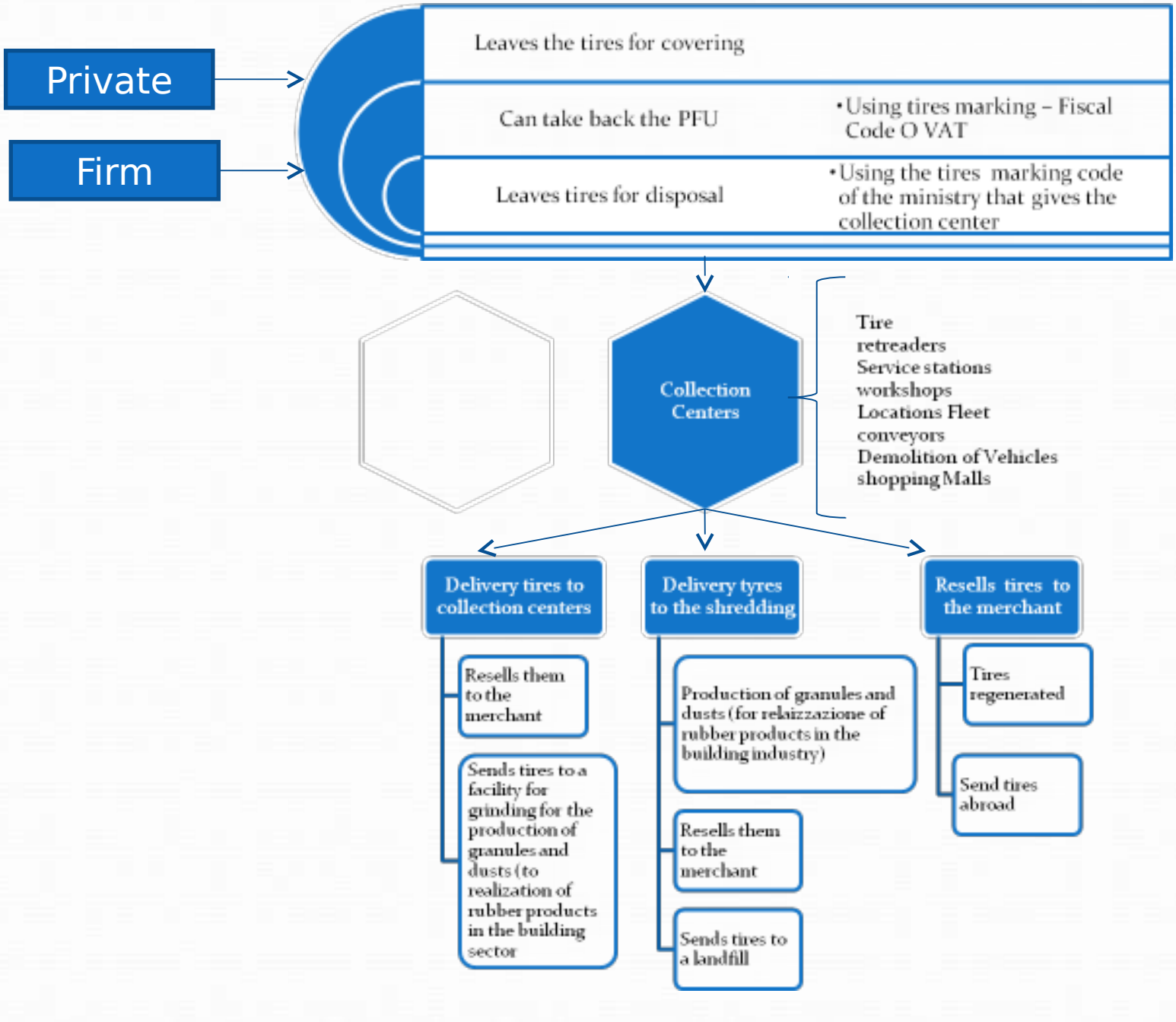
Send material to the disposal site

Dept. for Check Irregularities



Administrative sanctions

Tires Circuit



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Attachment 6

Renewable Power
Development EUROPE, s.r.l.

Global Environmental
Energy Solutions

RPH Renewable Power Holdings Incorporated

Global Environmental Energy Solutions

INTRODUCTION

Renewable Power Holdings Incorporated - RPH- is a specialized developer of alternative energy projects that use a variety of state-of-the-art technologies to convert renewable fuel sources, such as agricultural wastes & biomass or animal waste into clean energy.

RPH uses thermal gasification and other technologies to convert renewable fuel sources into clean energy. RPH build, own and operate renewable energy facilities that ultimately help to reduce the global consumption of fossil fuels. The systems used, provide clean sustainable solutions to a variety of waste disposal problems while generating clean alternative.

RPH owns 100% of two separate operating companies, Renewable Power Development, LLC (**RPD**) headquartered in Denver, USA and Renewable Power Development Europe S.r.l. (**RPD-E**) headquartered in Vicenza, Italy.

BUSINESS MODEL

The rapidly growing renewable energy industry has a critical need for the expertise required to manage the development, construction and operation of distributed generation projects. Our primary strategy is to build, own, and operate (BOO) renewable energy projects, so that we retain the most value from our unique project development skills. We also develop smaller "turn-key" WTE systems, that address certain vertical markets that include biomass, sludge and animal wastes, by offering to build, operate and transfer (BOT) the projects for third-party customers. When selling small "turn-key" plants, RPH's operating companies include Operations and Maintenance (O&M) contracts to support these systems during the operating phase of each project. RPH has developed strategic relationships with leading technology suppliers to provide flexibility in meeting the specific technical objectives of each project. We have also established relationships with regulators and local development partners in each target market.

SERVICES

RPD is a developer of small-scale distributed WTE (Waste To Energy) and BTE (Biomass To Energy) renewable power generation plants in the Americas/Caribbean, while RPD-E has the same mission as RPD only focused on Europe.

RPD provides two types of services to its customers:

1. **Waste disposal services**
2. **Energy supply services**

Waste Disposal Services

Raw Municipal Solid Waste (MSW) is processed to remove the material that can be recycled (i.e. metals and glass) along with other inert components (i.e. sand and dirt) to produce refuse derived fuel (RDF) pellets. The RDF fuel pellets are then used as fuel in our energy systems.

Animal Waste (cow manure, chicken litter, pig slop) is processed, which in some cases includes drying, and is then used as fuel in our energy systems.

Municipal Sewage Sludge (MSS) is approximately 80-90% water, with the remaining material being waste solids. The MSS is processed and is then used as fuel in our energy systems. A portion of the waste heat from our thermal conversion system is sometimes used for drying the MSS.

Energy Supply Services

- Production of heat from our processing of biomass and waste fuels
- Conversion of the heat generated from our process into thermal energy, such as high pressure steam and/or chilled water
- Conversion of high pressure steam generated from our process into electricity

PARTNERS

RPH has developed strategic alliances with a variety of state-of-the-art renewable energy technologies and power industry specialists. The Company has established strategic relationships with the following companies:

- KMW Systems, Inc. - Biomass & waste gasification systems;
- PRM Energy - Biomass gasification systems (for rice hulls);
- Vista International Technologies, Inc. (ex Natahniel Energy) - Waste gasification systems ;
- MaxWest Environmental Systems, Inc – Biomass and Waste gasification systems, including RDF, chicken litter, plastics,sewage,sludges;
- WOW Energies –Pollution control & energy recover technology;
- L Con Engineering & Constructors Inc. – contracting;
- Progetek Srl – engineering services

RENEWABLE SOURCES

RPH e RPDE utilize different renewable sources to generate clean energy in their renewable energy facilities :

- Agricultural Waste & Biomass
- Waste Tires
- Municipal Solid Waste
- Animal Waste
- Municipal Sewer Sludge

Agricultural and Forest Byproducts

Biomass is a term traditionally used for agricultural and forest byproducts such as: hog fuel, slash waste (i.e. branches and leaves left over from timber operations), sawdust and shavings (from sawmills), rice hulls, corn stover (i.e. stalks and cobs), and sugar cane bagasse (cane residue after sugar recovery) .

Municipal Solid Waste

Municipal Solid Waste (MSW)generally refers to common household waste, including office and retail waste. MSW includes wastes such as durable goods (e.g. tires, furniture), nondurable goods (e.g. newspapers, plastic plates/cups), containers and packaging (e.g. milk cartons, plastic wrap), and other wastes (e.g. yard waste, food). The waste industry has traditionally focused on four primary methods of disposal: recycling, composting, land filling and Waste-to-Energy via incineration. There is a fifth disposal method for MSW that can provide a sustainable solution while generating clean energy.

Waste historically sent to landfills can be processed to recover the recyclable (i.e. metals, glass) materials and remove the inert (i.e. rocks, sand) materials. The remaining carbon-based material can then be shredded and densified, thus producing Refuse Derived Fuel (RDF).

Waste Tires

Waste tires, both passengers and truck tires, are processed by shredding them down to a 2” minus tire chip, into Tire Derived Fuel (TDF), which can then be used as fuel for our energy systems. TDF is an ideal fuel for our process as it is homogeneous and has a very high energy content.

Animal Waste

Animal waste (from chickens, cows and pigs) can be used as a fuel in our energy plants. In some cases the material must be dried and then processed before it can be used a fuel for our energy systems.

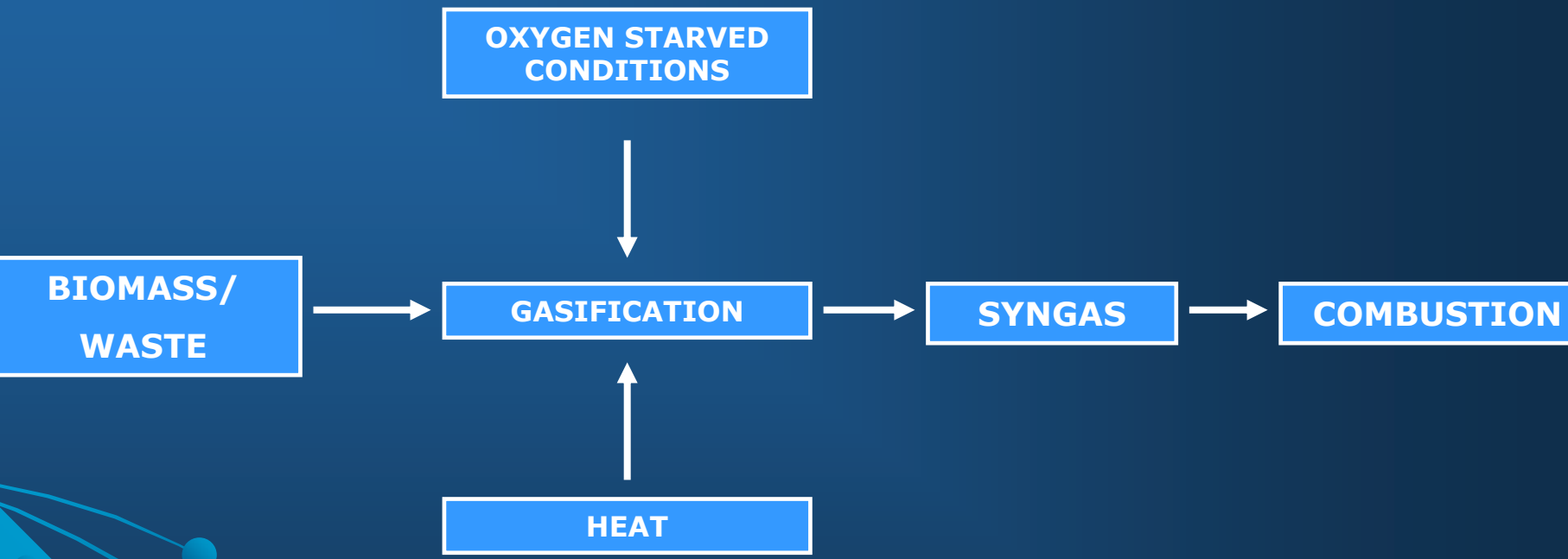
Municipal Sewer Sludge

Solid waste from water treatment plants (i.e. sewer sludge) is as much as 80-90% water. This material must be dried, using a thermal drying device to process the solids content into a fuel that can be used for our energy systems.

Gasification Process:

1. Gasification uses a controlled thermal-chimical reaction (versus the uncontrolled combustion reaction used in burners /incinerators) to breakdown solid fuels into a synthetic gas
2. The synthetic gas, called syngas, has a high calorific value
3. Syngas can be burned to generate thermal and electrical energy, or it can be used as a fuel in endothermic motors

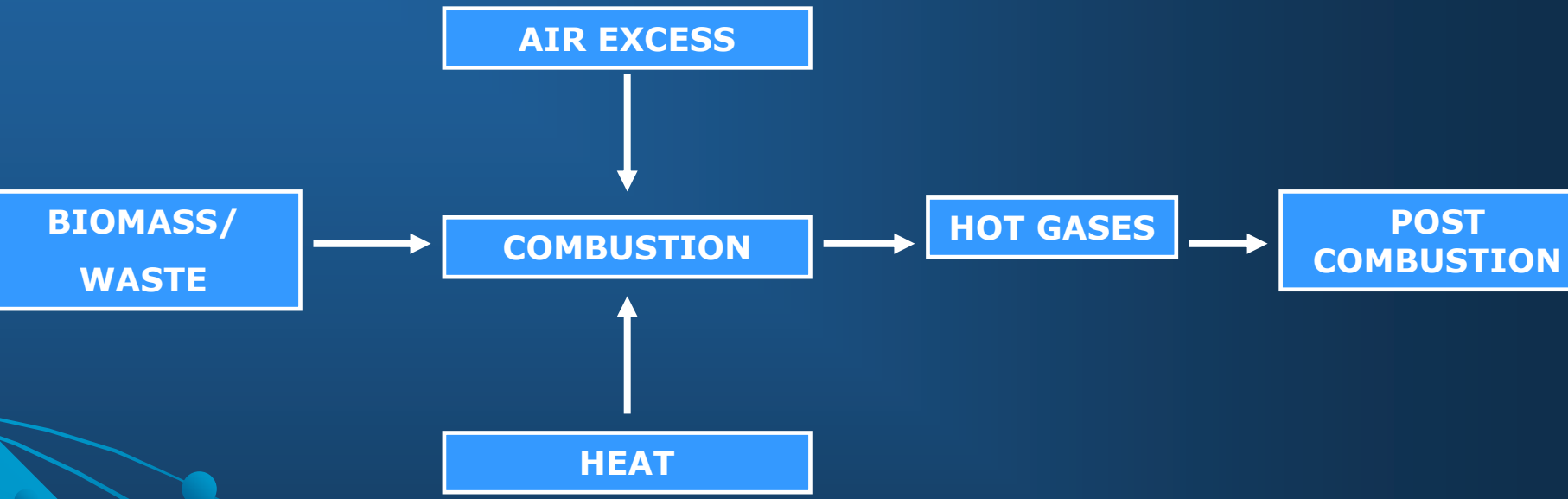
GENERAL FLOW CHART OF GASIFICATION PROCESS



Combustion Process

In the combustion process biomass and/or waste are directly burned at a solid state, in excess air conditions; the generated gases are then combusted in a specific section of the plant (after burner)

GENERAL FLOW CHART OF COMBUSTION PROCESS



GASIFICATION PROCESS HAS FOLLOWING ADVANTAGES:

- Requested airflow rates are about 1/3÷1/5 than traditional combustion process;
- In gasification process biomass/waste is converted in syngas; syngas is then burned in air excess conditions, obtaining a very good combustion and cleaner exhausted gases;
- In combustion process biomass/waste is directly burned in air excess conditions; due to particulate transportation, exhausted gases are consequently less clean;
- In gasification process exhausted gases outflow is lower than combustion and gases are cleaner; the amount of combustion products released in the atmosphere is consequenly lower than traditional combustion.

Gasification – General

Our Waste To Energy (WTE) and Biomass To Energy (BTE) solutions utilize state-of-the-art gasification technologies as an alternative to traditional combustion systems.

Gasification represents a solution for two problems:

1. Waste disposal
2. Production of clean energy

Waste Disposal

Biomass
Tires Waste
Animal Waste
Municipal Solid Waste
Municipal Sewer Sludges

Renewable Energy

Gasification uses carbon-based materials as feed stock to create energy .

During gasification process, under controlled conditions inside the gasifier, the feed stocks undergo a chemical transformation due to extremely high temperatures in an oxygen starved environment to produce a gaseous fuel known as synthesis gas (Syngas). Through this process it is possible to extract energy from a variety of organic materials (i.e. RDF, sewage sludges, animal wastes, etcv.).

The active components in the Syngas are carbon monoxide (CO) and hydrogen (H_2), with inert nitrogen (N_2) and carbon dioxide (CO_2) diluting the fuel when air is used ti supply the oxygen used in the process.

Gasification - Technology

The gasification of solid fuels is characterized by two phases which takes place in two different sections of the gasifiier: Primary Chamber (Gasifier) and Secondary Chamber (Oxidation).

In the Primary Chamber the fuel is converted in a gaseous fuel known as syngas; syngas is then transferred to the Secondary Chamber where at high temperature in an oxygen starved environment oxidation is undertaken.

The thermal energy in the exhaust can be recovered in either a high pressure (HP) super-heated steam boiler or an Organic Rankine Cycle (ORC) system.

The HP steam is used to run a steam turbine generator (STG) to produce electricity. For industrial applications requiring a Combined Heat and Power (CHP) configuration, some of the steam can be extracted from the STG at lower pressures, reducing the amount of electricity generated, to deliver the thermal energy that is required in addition to electricity.

The ORC system is primarily used to generate electricity, but if low temperature heat can be used for a CHP application, this is also available. The exhaust gases from the heat recovery system (i.e. boiler or ORC) are sent to a pollution control system to remove any remaining ash (i.e. Fly Ash) and scrub out any harmful contaminants such as HCl or SO2 (which produce acid gases). The final emissions are continuously monitored to ensure compliance with all air emission permit conditions.

The gasification technologies used meet all current EU and US environmental standards.

There is a third configuration where syngas is feeded into endothermic engines generator sets, to recover electricity and heat. Syngas, from Primary Chamber, is requested to be cooled, cleaned and conditioned for firing internal combustion engines.

Gasifiers can be of two different types:

- Vertical Gasifier
- Horizontal Gasifier

Vertical Gasifier

The vertical gasfier is effective with homogeneous and light feed stocks only.

The vertical design is simple, requiring few moving parts, and provides ease of control. This design results in high on-line availability, with the exception of the time required to “clean out” the ash system.

The gasifier operates at slightly negative pressure which provides tow benefits. First, the fuel feed system does not have to overcome a significant pressure differential, which results in a basic, dependable feeding system.

Second, any leakage is ambient air entering into the controlled process conditions, and not leakage of combustible Syngas out into the atmosphere, thus maintaining safe operating conditions.

However, despite these benefits, these units must come off-line for maintenance of the ash beds. Additionally, waste fuels that are introduced to vertical systems must be limited to light weight homogeneous feed stocks or the materials will drop too rapidly through the gasification zone. Beyond the efficiency losses, this creates ash removal issues and disposal problems due to unburned carbon (i.e. unused fuel) in the ash.

Horizontal Gasifier

The horizontal gasification method provides for more fuel flexibility and control. This control is provided by a mechanical system that moves the fuel through the different zones in the gasifier.

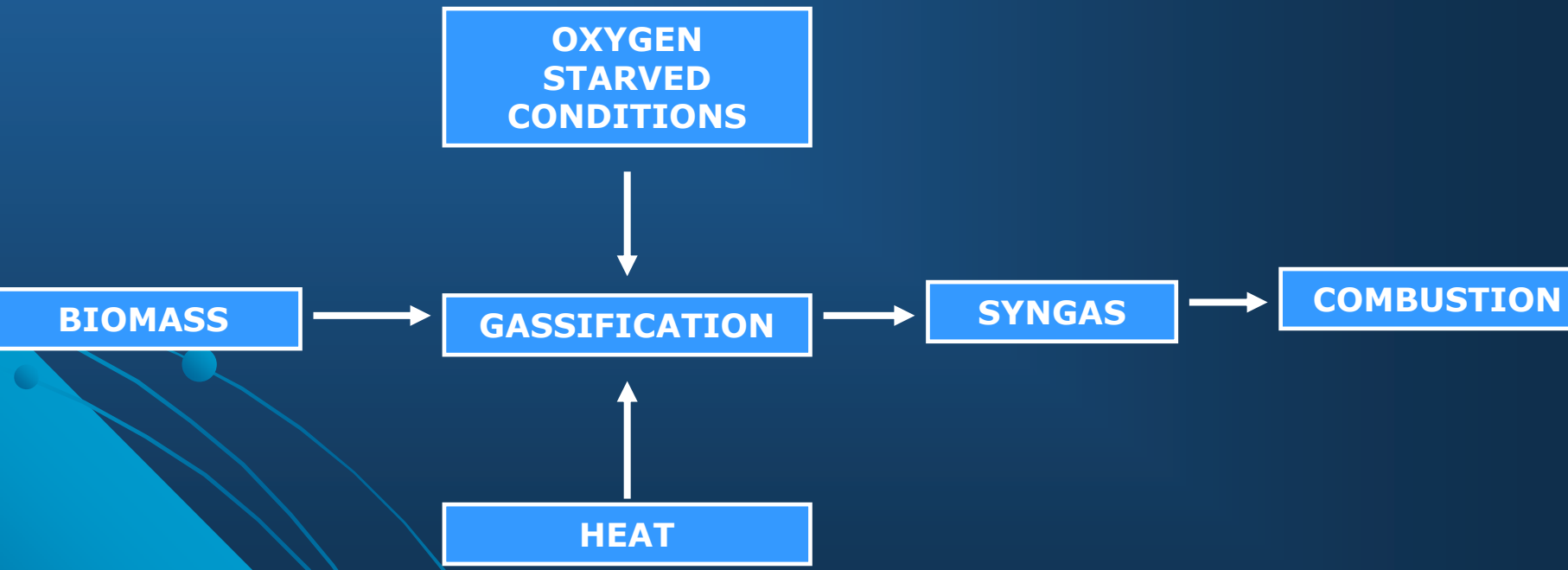
This allows the operation to be "tuned" to deliver the residence time in the gasification zone required based on the specific fuel chemistry.

In the first zone, low heat is used to dry the fuel. In the second zone, high heat induces thermal decomposition of the solid carbon-based (waste) fuel material to produce Syngas.

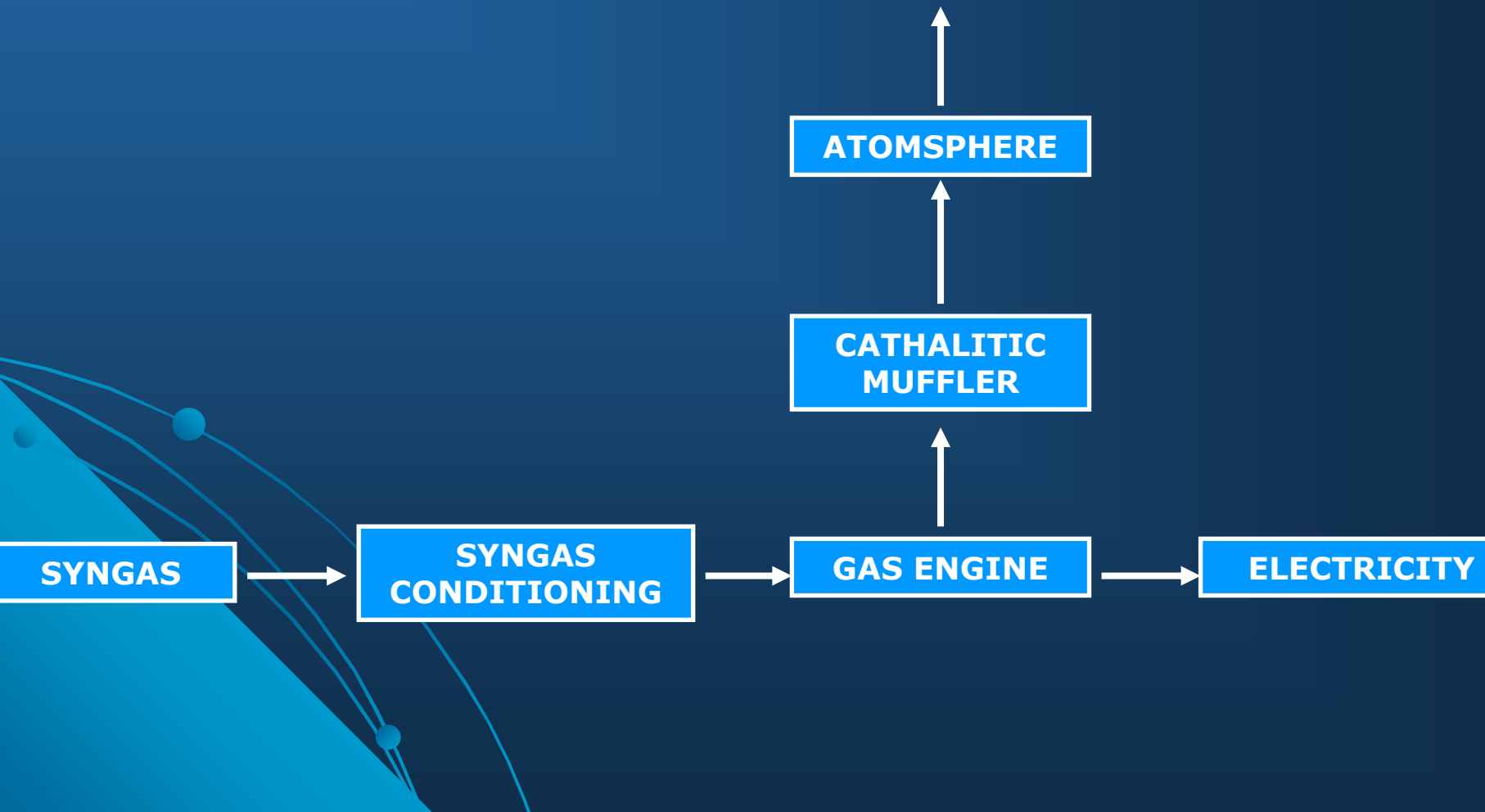
The sub-stoichiometric conditions (i.e. oxygen starved) prevent the combustion of the Syngas.

In the final zone, additional air is used to fully oxidize the remaining carbon char to generate the heat required to sustain the reaction in the first two zones. Bottom ash is collected at the end of the fuel path.

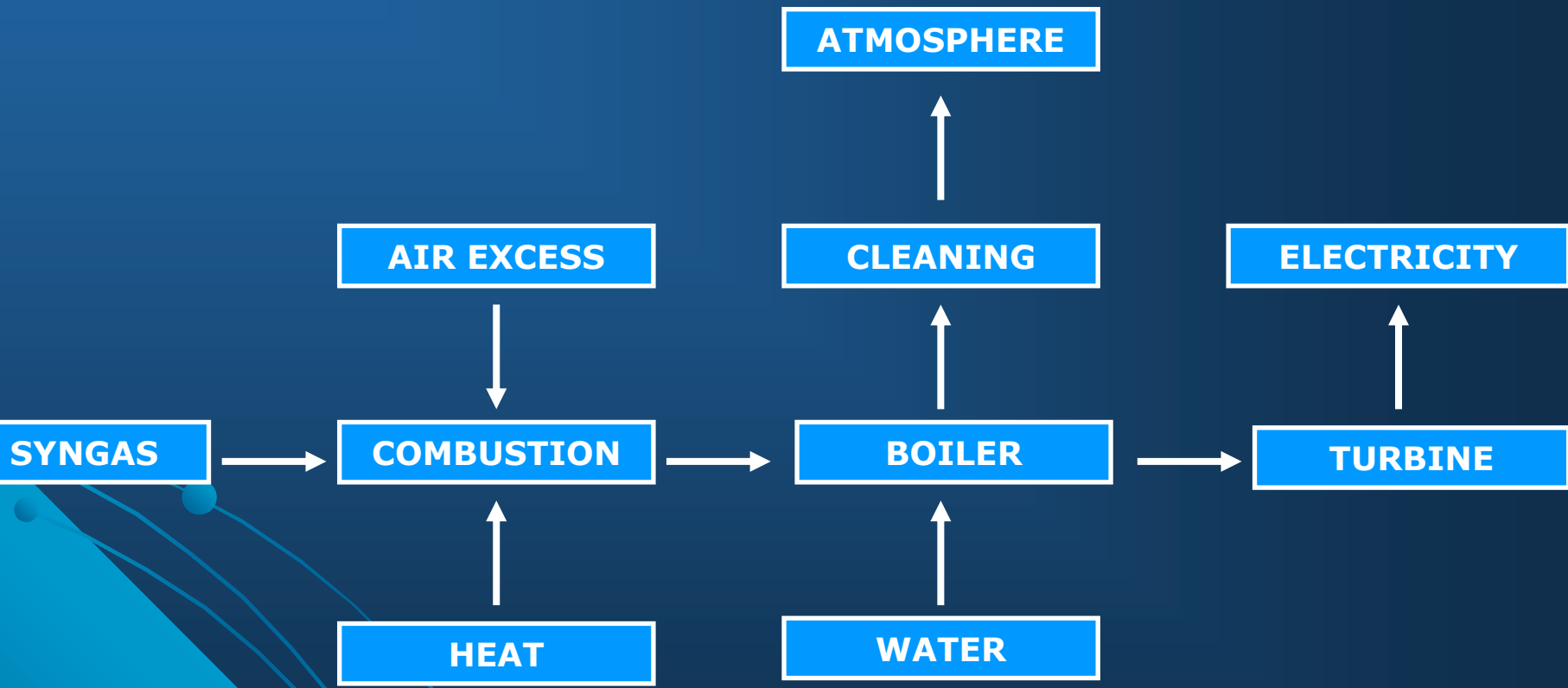
FLOW CHART OF GASIFICATION PROCESS
(SYNGAS COMBUSTION)



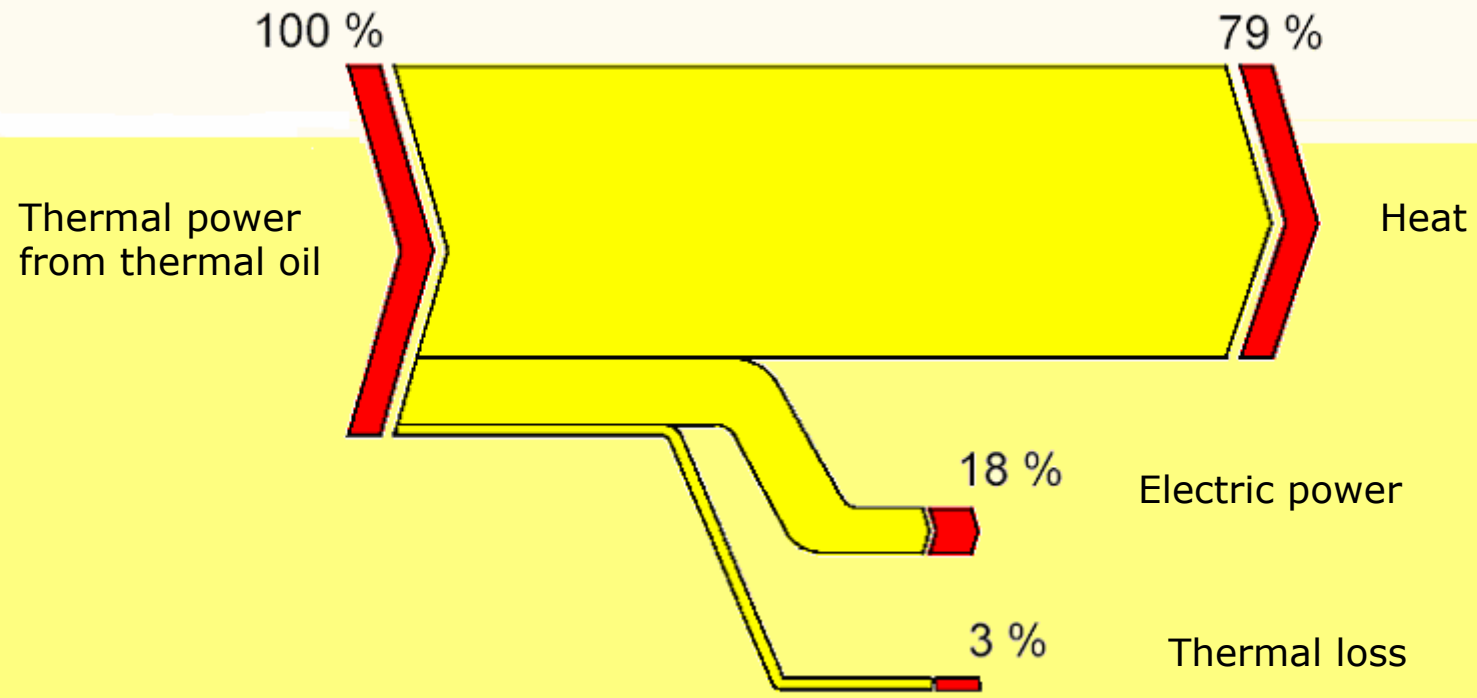
FLOW CHART OF ENDOTHERMIC ENGINES CONFIGURATION



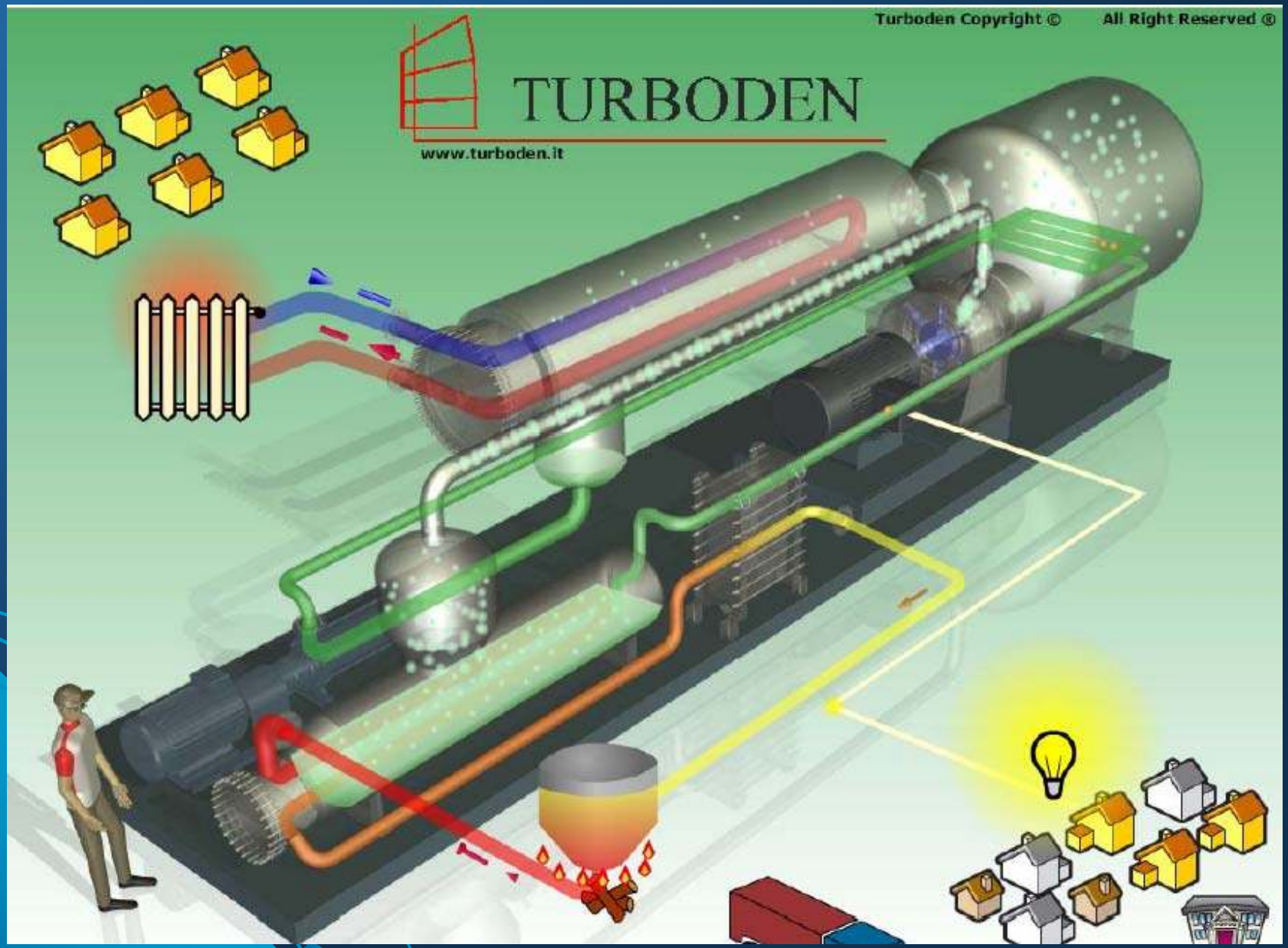
FLOW CHART OF BOILER COMBUSTION CONFIGURATION



ORGANIC RANKINE CYCLE CONFIGURATION



Energetic Diagram



ORC EQUIPMENT

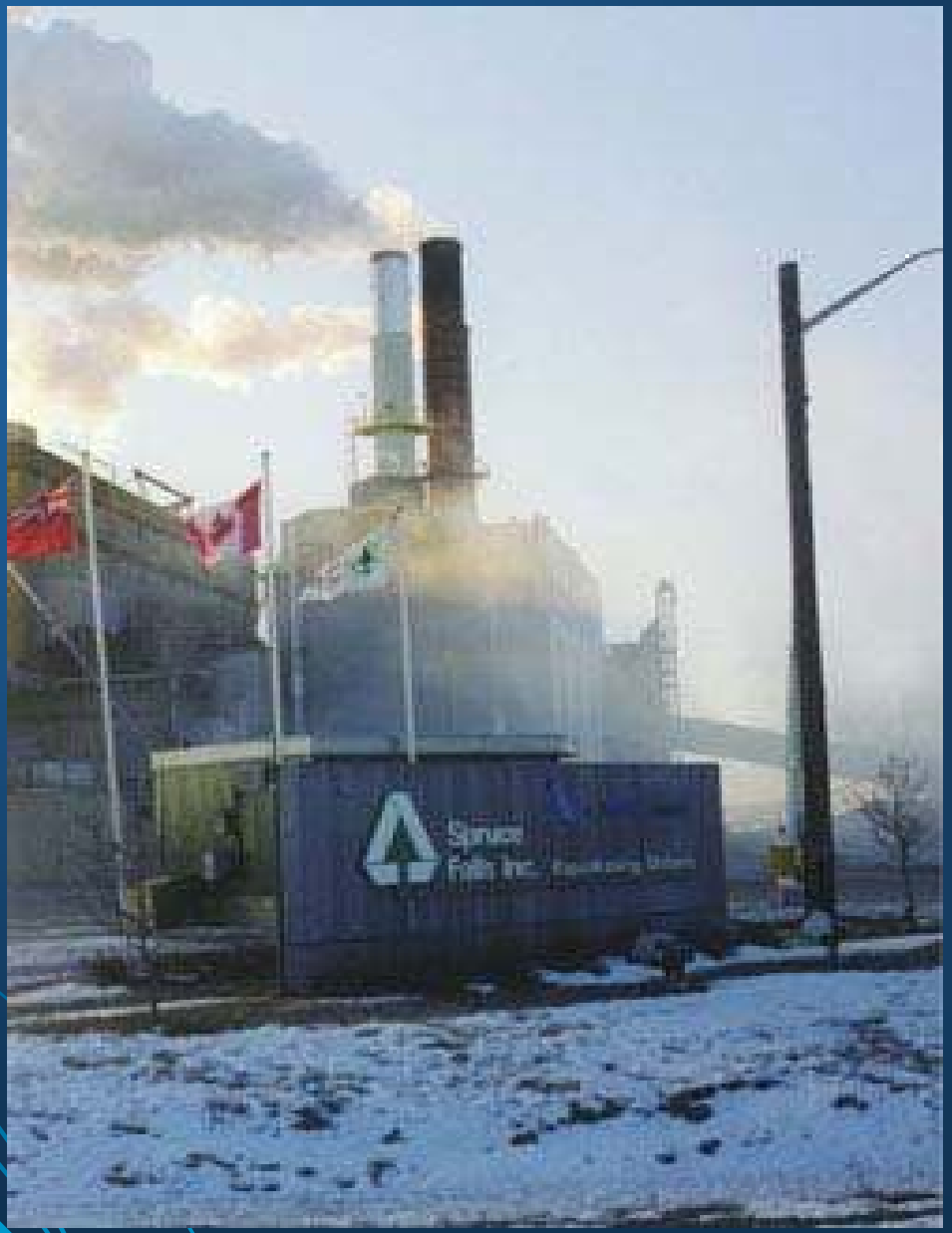
REFERENCE LIST

RPD has realized many renewable power generation plants in USA and in Canada. We enclose a short list of our installations

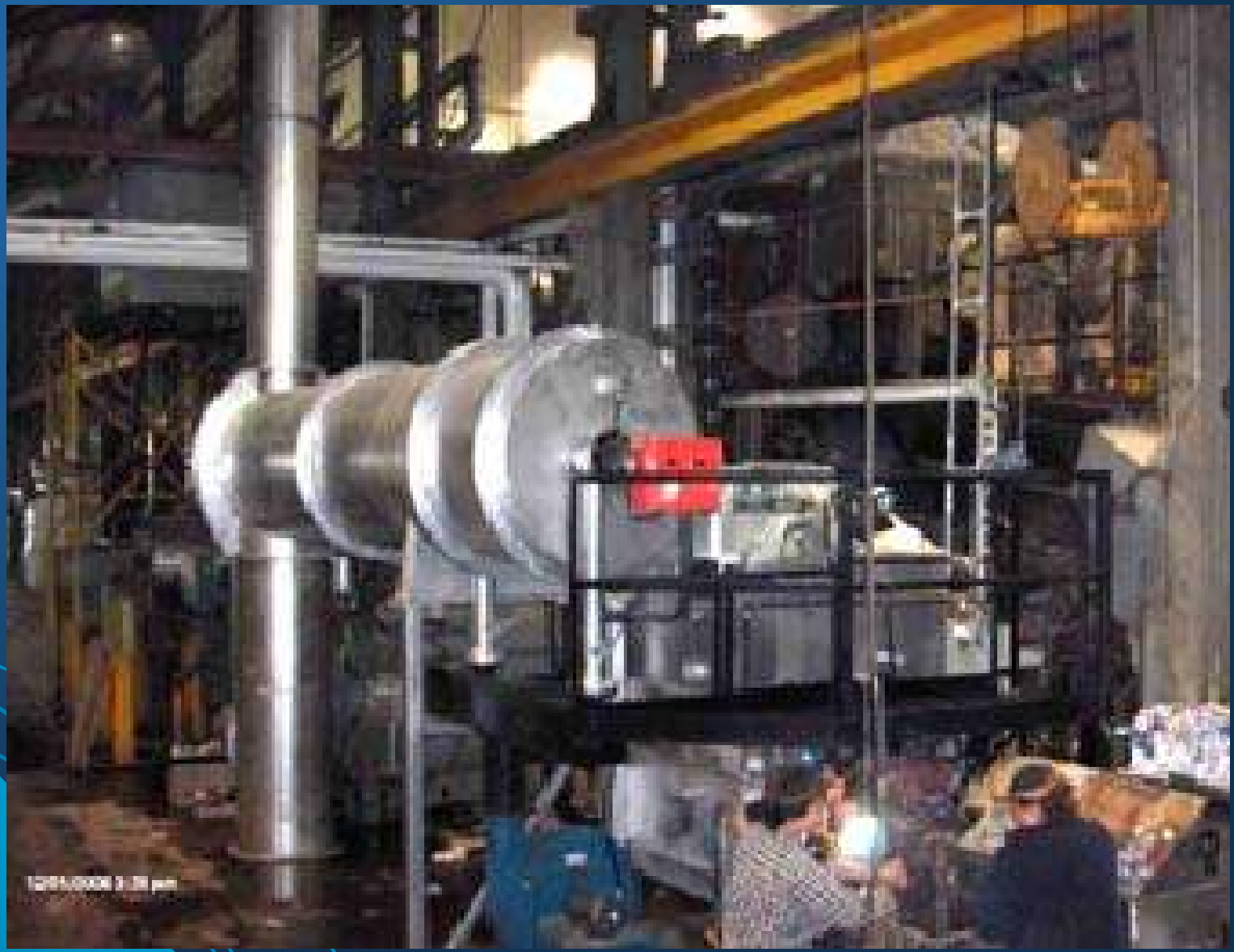
- Municipal Sewer Sludge gasification plants (including thermal drying)
- Paper mill, pulper and barks gasification plants
- Plastics rejects from MSW sorting gasification plants
- Animal wastes gasification plants
- RDF gasification plants
- Biomass (wood chips and barks) gasification plants

Municipal Sewer Sludge gasification plant, Philadelphia, Pennsylvania (USA

Municipal Sewer Sludge gasification plant, Sanford, Florida (USA)



Paper mill, pulper and barks gasification plant, **Kapuskasing, Ontario (CANADA)**



Plastics rejects from MSW sorting gasification plant, **Alberta (CANADA)**

Chicken litter gasification plant, Wardensville, West Virginia (USA)

Turkey litter gasification plant, Northfield, Minnesota (USA)

Wood chips and barks gasification plant, Foothill Greenhouses, Ontario (CANADA)

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