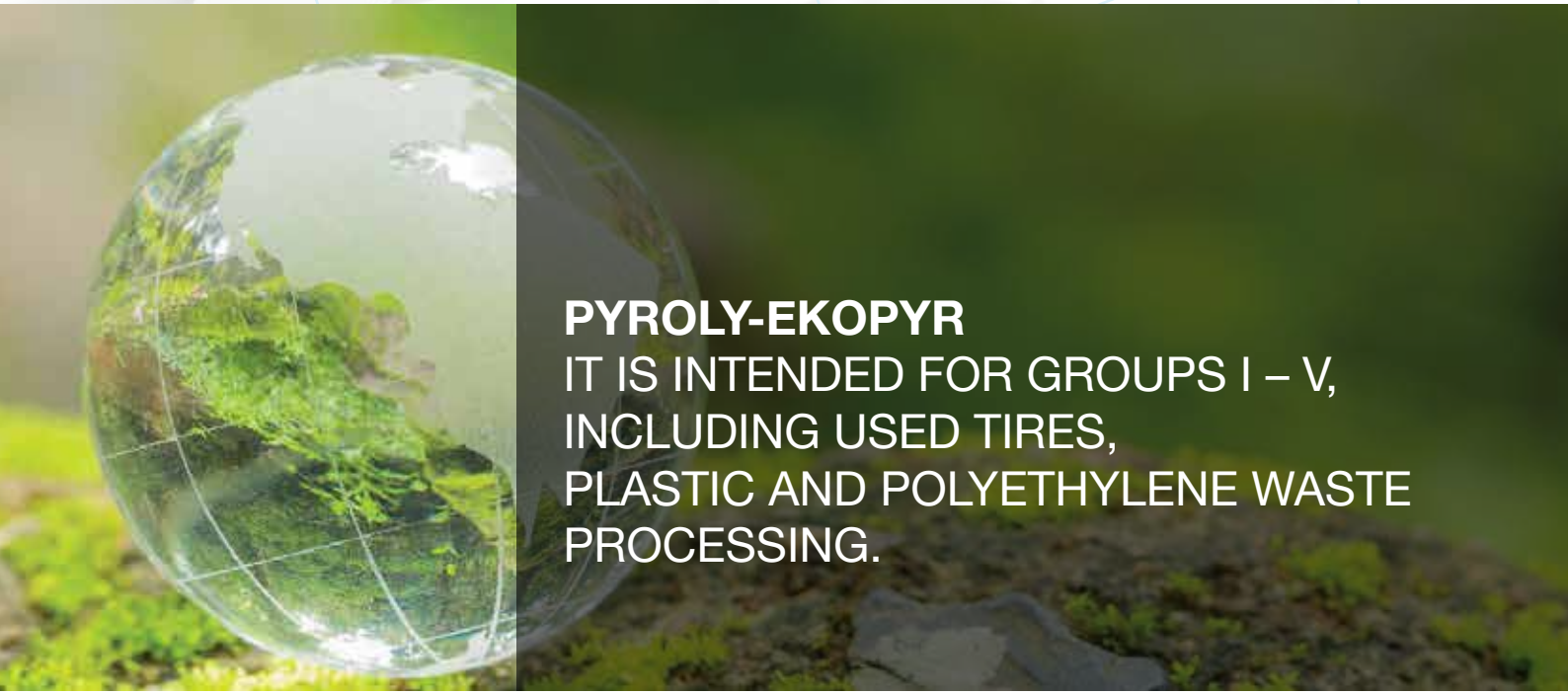
CATALANA
Technologies and Development

PYROLY®
www.pyroly.com

A COMPLEX SOLUTION TO SUPPLY THE REGIONS WITH ELECTRICITY, HEATING AND FUEL OBTAINED BY RECYCLING VARIOUS HOUSEHOLD AND INDUSTRIAL WASTE.



PYROLY-EKOPYR
IT IS INTENDED FOR GROUPS I – V, INCLUDING USED TIRES, PLASTIC AND POLYETHYLENE WASTE PROCESSING.

BRIEF DESCRIPTION AND MAIN FEATURES

CATALANA OÜ Reg. No. 10651017 (Environmental Permit Registration Number KL-509045), is a co-founder of the international consortium group of companies "PYROLY". The international consortium "PYROLY" was created by a group of companies in 2018 to carry out projects for the construction of complexes, including the production of industrial plants for further use, equipped with "PYROLY-EKOPYR", which radically changes the principle of waste reception and treatment without creating competition with existing waste management companies.

Specialists from the companies in The PYROLY Consortium have created more than 10 prototypes for the treatment of different types of waste at various stages of cooperation, which have been successfully tested and later become prototypes for the following products that can treat different types of waste from 50 to 10,000 m^3 per day:

1. Treatment of waste oils and acidic bitumens "PYROLY-EKOPYR" **OS** "
2. Processing of rubber, plastics and polyethylene "PYROLY-EKOPYR" **RP** "
3. Treatment of all types of waste mixtures "PYROLY-EKOPYR" **EG** "

The "PYROLY-EKOPYR" complexes, which we have manufactured in our production base using the latest technology, are unique and dominate in terms of productivity, production and price elsewhere in the world as a waste recycling plant.

In the first stage, the gasification of solid or liquid waste takes place in a turbulent mode in the plant's pyrolytic reactor. It produces a gas that contains carbon monoxide, hydrogen and hydrocarbons. Typically, the gas from the treatment of waste containing organic compounds contains, in addition to hydrogen, carbon monoxide and dioxide, etc., an aerosol consisting of very small droplets of hydrocarbons or resins with a chemical temperature of 450-500 ° C, then passes through a zone with a temperature of is 850 ° C, after which it no longer contains unburned carbon, organic residues and dust.

High gas flow rate in the gasifier due to the supply of inert gas heated to extremely high temperatures by turbulent blowers, resulting in no particulate matter in the produced gas. Gasification takes place at atmospheric pressure.
The gas resulting from the treatment is partially condensed in special vessels aimed at cooling the gas-liquid, the non-condensable gas fraction is burned in a honeycomb heat generator, allowing the inert gas to be heated to extremely high temperatures and increasing its entry into the PYROLY-EKOPYR reactor due to accelerated gas expansion.

– The advantage of the proposed technology is its high energy efficiency.
– At the gasification stage, the efficiency of external energy sources reaches 97%.
– Possibility to treat solid and liquid waste with high ash content and very moist waste, which is poorly treated in other equipment, producing soot and other products of incomplete combustion.
– Relative simplicity and low cost.
– High environmental friendliness of the process: complete combustion, absence of soot, carcinogens and other toxic substances, absence of dust in flue gases.
– Easy preparation of raw materials.
– No fine crushing and grinding steps.
– Technological options are possible due to the production of a high-purity, completely sulphur-free liquid (synthetic oil).

FEATURES:

1. Our complexes enable processing of all kinds of municipal solid waste (MSW), oil waste, rubber products, plastics, organics, medical waste, agricultural waste and others, both separate and unsorted, except glass and metal.

2. The temperature range of the reactor is adjustable from 350° to 1150°, which makes it possible to obtain low temperatures from 350° to 850° (furnace oil) and high temperatures from 850° to 1150° (heat and electricity).

3. Possibility of changing temperature regimes makes it possible to switch reactor operation to heat and electric power production in a short period of time (at the same time it is necessary to add GTU (gas turbine power plants) or GPU (gas piston power plants) in reverse order to produce pyrolysis oil).

4. The unit has a unique environmentally friendly process - complete combustion, absence of soot, carcinogens and other toxic substances, absence of dust in the flue gases (exhaust gases are not emitted into the atmosphere) and the versatility of the input raw materials, as well as the unique

5. Easy preparation of raw materials. No fine crushing and grinding stages. Technological options to obtain high-purity, completely sulphur-free pyrolysis liquid (synthetic oil) are possible.

6. The process of reception and recycling allows not to create new landfills after waste sorting, as the waste is a basic raw material. After separating metal, glass, concrete blocks and other secondary waste. The waste is taken directly to the production site where it is 100% recycled.

7. The equipment is also designed to recycle existing landfill sites, with the possibility of using waste-free, uncontaminated areas for any future purpose.

THE OFFER

Creating a business area in Estonia, a project that will radically change the approach to recycling and waste treatment. Opening up new market segments, where waste is seen as a raw material for heat, electricity and fuel.
The proposal is based on the idea of setting up a joint venture, with subsequent installation of complexes at designated sites and organisation of processing of the required groups of raw materials. Also, if necessary, selling processing equipment for all types of municipal waste and most of the 1-5 hazardous industrial waste to small and medium-sized companies.

The development of this business area involves the installation of 48 recycling complexes for different types of raw materials in Estonia. All of the installed complexes perform tasks that are defined by business projects - heat production, electricity production, fuel production or all together.

On the whole, this project could completely solve the issue of diesel consumption in Estonia, as an example (according to statistics, Estonia consumes 647,000 tonnes a year), if 48 complexes of 200 m³/day are processed into fuel or, if necessary, heat and electricity - possible production is shown in the table on page 18. that state support is needed to move such a large-scale project forward as quickly as possible, these are specialised agencies and organisations with whom joint ventures can be formed for project implementation, combining different

MAIN CONCLUSIONS

The planned integration of known and practically tested technologies into a single technological chain in the investment project will allow to use waste efficiently and completely, to extract energy, heat and other products contained in waste, raw materials from which become alternative sources of energy.

The rational integrated use of advanced technologies solves the problem of neutralisation, concentration, release and disposal of toxic components and harmful emissions, including dioxins and heavy metal salts, and thus minimises the negative impact on the environment.
The proposed complex and the correct proportions of the use of different technologies will ensure very cost-effective production of other raw materials and marketable products, which will not increase the costs arising from the city budget for sanitation and waste disposal.

Implementation of the project will enable the city authorities, enterprises and organisations, entrepreneurs and the public to solve waste problems in a short period of time using modern methods, improve environmentally clean areas around the complex and create tangible prerequisites for socio-economic development of the city. This project solves both environmental problems and additional jobs, who live in an energy-efficient house and can participate in projects as an investor and receive a stable income.

The technology offered by our specialists makes it possible to create eco-settlements for young and low-income citizens, who have their own infrastructure for sorting and recycling waste, providing them with fuel, heat and electricity for the needs of people living in the eco-houses. This creates better living conditions.

With state support, this project will modernise the electricity and heat networks and replace outdated boiler plants. All works will be carried out in stages according to an agreed schedule. The company will finance these works, maintain the networks and, if necessary, repair them.

The proposed concept could become a business card for Estonia, a country that has been able to solve its own energy and environmental problems and has offered other EU countries a proposed approach to solving this problem by using our proposed technology and equipment.

In the future, this technology will make it possible to plan the construction of settlements, cities and other public formations according to completely different principles.

INFORMATION FOR REFERENCE

Price of electricity to become more changeable in the future

The market price of electricity will come to fluctuate to a greater degree as countries switch to renewable energy and close coal and oil shale power plants. Kalev Kallemets, CEO of nuclear plant project company Fermi Energia, predicts that prices will continue to rise, while Estonian transmission network operator Elering disagrees.
The past week has seen the price of electricity on the Nord Pool exchange reach €100 per megawatt-hour for at least a few hours every day. The price climbed to €255 two weeks ago. Cheaper times see a megawatt-hour of energy cost €30-40. Estonia imports roughly half of the energy it needs when its quiet and warm like this, Kallemets said. "We are importing around 1,000 megawatts from Finland, while half of it moves on to Latvia."

Stable sources to be closed

Kallemets said it is a problem that major countries are closing plants that used to ensure stability on the open European energy market. Germany plans to close three nuclear plants this year and the last three next year. Belgium is also set to shut down a reaction the year after next.
"Considering the rise in CO2 quota prices and coal plants being closed ahead of schedule, serious questions of supply security in Europe will arise," Kallemets said.
"Such capacity is obviously needed during the hours and days when the wind is quiet, like this past week." "Considering that the rise in CO2 prices is inevitable – as it should be for carbon neutrality to be achieved – the annual average price of electricity will grow. Everyone is saying that we will only see an increase in price volatility, while higher prices are also inevitable in the long run," he said. "Europe is connected, meaning that prices are very low when there is plenty of wind power on the market and very high when the wind dies down," the Fermi Energia CEO said, adding that building small modular nuclear reactors in Estonia needs to be considered. "Wind farms absolutely need to be built, but they cannot ensure supply security," he said.

Elering: transmission network operators have counted on old plants being closed.

While the closing of old plants and CO2 quota price hikes affect the market, this is aimed at pushing for greener energy sources. "We will definitely see greater volatility or price fluctuation in the future. However, temporarily higher prices will make it possible to construct power plants that would not be cost-effective in the conditions of constantly low prices," Köster explained.

Electricity prices rise more than double EU average in first half of 2021

Estonia saw one of the highest rates in growth of electricity prices in the first half of 2021, compared with the same period in 2020. These figures were posted before the more recent, record level of electricity and natural gas prices; the latter actually dropped slightly in Estonia in the first half of the year. While electricity prices rose 7 percent on year in the first half of 2021 in Estonia, the average for the EU as a whole stood at 2.8 percent over the same period, BNS reports.

Hungary (€10 per 100 Kwh) and Bulgaria (€10.20 per 100 Kwh) saw the lowest electricity prices EU-wide, while at €31.9 per KWH, German posted the most expensive rate, while Denmark, Belgium and Ireland also had high prices, in excess of €25 per Kwh. Slovenia saw the highest electricity price rise, at 15 percent, while Estonia was in third place, joint with Romania at 7 percent as noted, and behind Poland (8 percent).
Lithuania, on the other hand, experienced the third highest electricity price fall over the first half of 2021, compared with the same period in 2020, at 6 percent, behind only Cyprus (7 percent) and the Netherlands (10 percent, largely due to a tax cut). The EU average price of electricity was €21.9 percent per Kwh, with taxes and excise accounting for 39 percent of this. Estonia has also seen severe electricity price rises in the second half of the year so far, with records set and then promptly broken several times earlier in October, and a support package for low income households rolled out for the winter season (October to March next year). The price on the Nord Pool market as of €95.01 per Kwh; a day earlier it had stood at €66.21 per Kwh, while on October 19 the price was €140.68 per Kwh.

Gas prices

Natural gas prices to household, meanwhile, dropped in Estonia over the same period, at a sharper rate (1 percent) than the EU average (0.5 percent), according to Eurostat.
Gas prices across the EU were lowest in Lithuania (€2.8 per 100 Kwh) and highest in the Netherlands (€9.6 per KWH), while the highest growth was seen in Denmark (19 percent), in the first half of 2021.
Natural gas prices dropped in 20 member states, however, with the largest drop again coming in Lithuania (23 percent).
The average price of natural gas EU-side in the first half of 2021 was €6.4, and taxes and excise duties accounted on average for 36 percent of the total.The second half of the year has seen steep gas price rises in Estonia, largely the result of increases on the world market.

Record natural gas prices affecting both companies and regular consumers

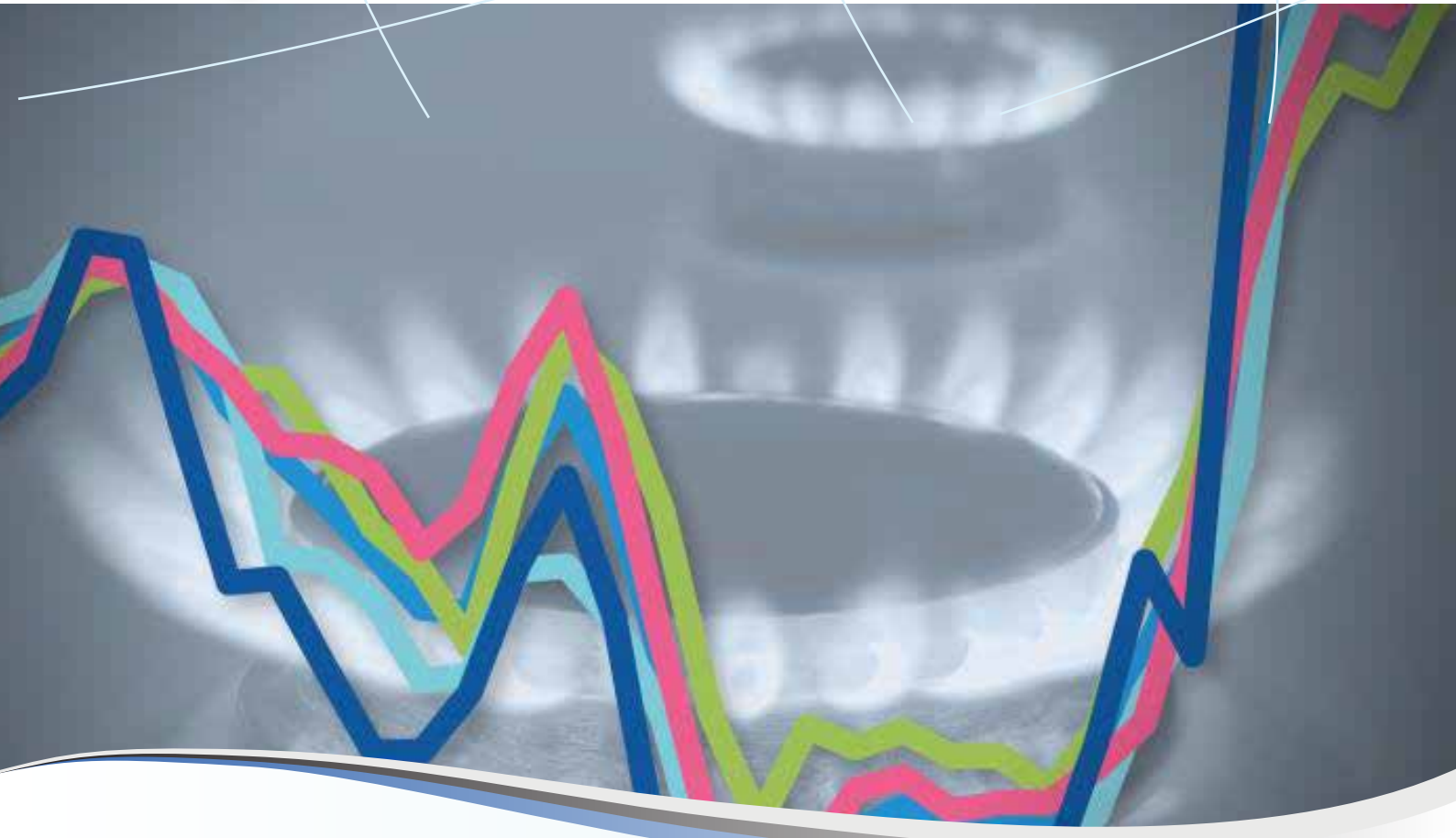
The price of natural gas hit a new record on Wednesday, reaching a price of €160 per MWh. The price of natural gas has grown sixfold in the past year, affecting both companies and household consumers.

"Our bill was only €50 for February. But now with this price increase, we will certainly have to switch providers, because the bill will increase and come to € 200."

Market leader Eesti Gaas provides gas to a total of 42,000 private consumers and apartment associations. Nearly half of Estonian households are heated with district heating, the prices of which are regulated by the Competition Authority. Data from the Estonian Power and Heat Association shows that 60 percent of thermal energy is produced from wood chips, but a fifth of district heating stations also burn natural gas. Most heating stations dependent on gas are in Pärnu and Põlva counties, according to the association's chief Siim Umbleja.
Tarmo Kirotar, head of Põlva Soojus, a regional heating company, said producing 30,000 MWh of heat consists of a third of natural gas and two thirds of wood chips.

Eesti Gaas board member Margus Kaasik said the price of natural gas stayed at €20 per MWh for a long time and began increasing in spring. It was around €50-60 up until a month ago.

Wednesday's record price meant the price of natural gas has gotten eight times more expensive. "I really hope what we saw [on Wednesday] is the peak of the market and we see it normalizing fast. Looking at market estimates on future transactions, we will go back to €40 in April or May and hopefully even lower from there. Prices should go down after the first quarter," Kaasik said. He added that the winter will be a



Garbage and Waste are raw materials for the production of heat, electricity and fuel at an affordable price, without harming the environment.

Garbage and Waste are raw materials that can significantly reduce labour costs in agriculture and accordingly, significantly reduce the prices of products and goods produced (heat, electricity and petroleum products).

Garbage and Waste and their proper management - reducing dependence on traditional energy sources (gas, oil), a green planet today and in the future.

Garbage and Waste - products for life made of environmentally friendly materials at an affordable price.

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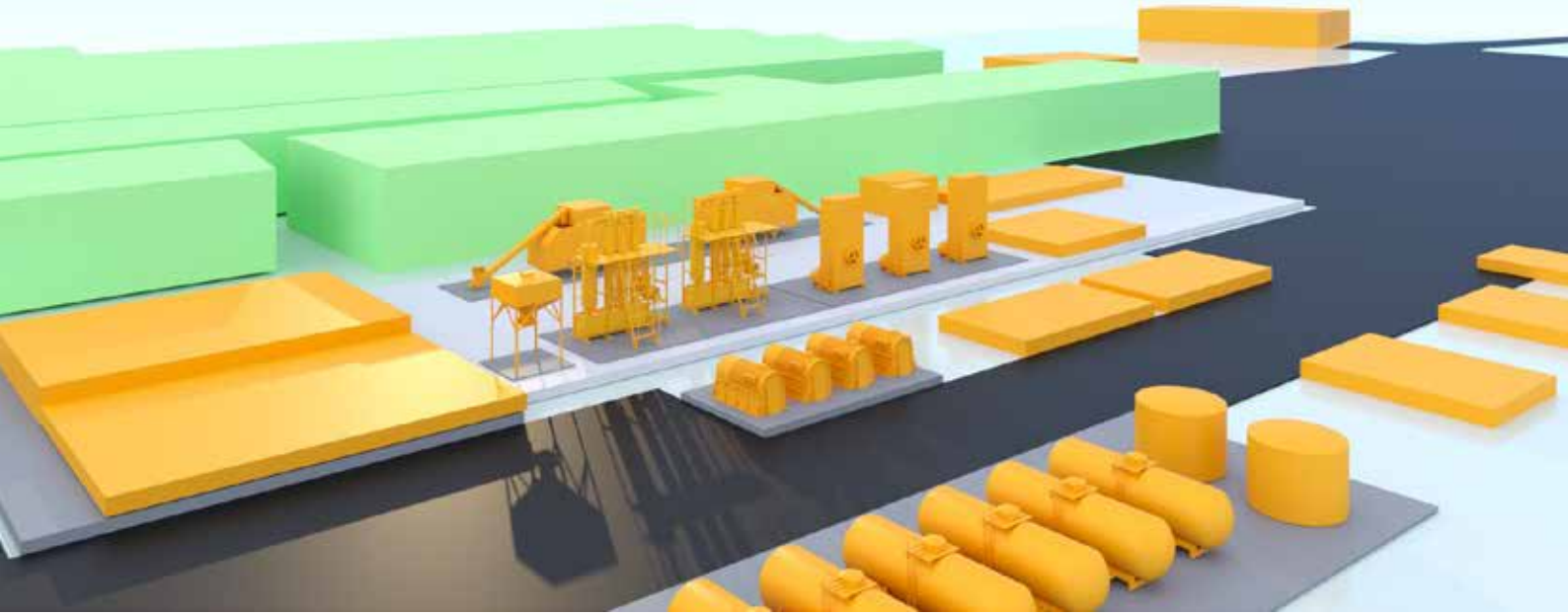


Block 1 - Absorption station.

The station operates in semi-automatic mode.

Work process:
1. coarse filtration of fuel from storage,
2. pumping fuel through absorbers,
3. Fuel Supply Unit No. 2 through medium thickness filters.

Block 2 - Final cleaning of fuels and lubricants.

Work process:
1. ultraviolet fuel cleaning.
2. Pumping fuel to Unit No. 3 through fine filters.

Block 3 - Delivery of fuels and lubricants to tanks.
The dosing unit regulates the amount and speed of fuel from the pump.

Block 4 - Pyrolysis liquid fractionation plant.
The pyrolysis liquid is separated into light (petrol / diesel) and dark (heavy fuel / bitumen) fractions by heating to a certain temperature.
Selected fuel fractions are pumped from the fuel depot to the storage facility.

Block 5 - Propane / Butane Liquefaction Plant.
The gas mixture is a by-product of the pyrolysis liquid fractionation. The gas mixture is liquefied, where one part of the liquefied gas enters the emergency tanks, the other part of the gas is led to the burners of the No. 4 device. The combustion products of the fuel gas are removed to the unit for cleaning and further liquefaction. No. 11.

Block 6 - Fuel depot.

Block 7 - crushing of raw materials.
The raw materials delivered for crushing are loaded into a receiving hopper, where the 1st conveyor takes them and directs them to the crusher. The 2nd conveyor under the crusher transports the crushed raw material to the intermediate hopper, from where the 3rd conveyor delivers the raw material to the receiving hopper of the pyrolysis reactor.

Block 8 - Technical Hydrogen Recycling.
Technical hydrogen is the dry residue from the processing of raw materials in a pyrolysis reactor. The carbon is fed by a screw conveyor from the hopper No. 14 to a vibrating screen to separate the ash, after which it is crushed to the required fraction. The crushed carbon passes through a magnetic separator and is packaged.

Block 9 - Pyrolysis Reactor.
It processes raw materials to obtain useful products: technical hydrogen, pyrolysis liquid, synthesis / gas.

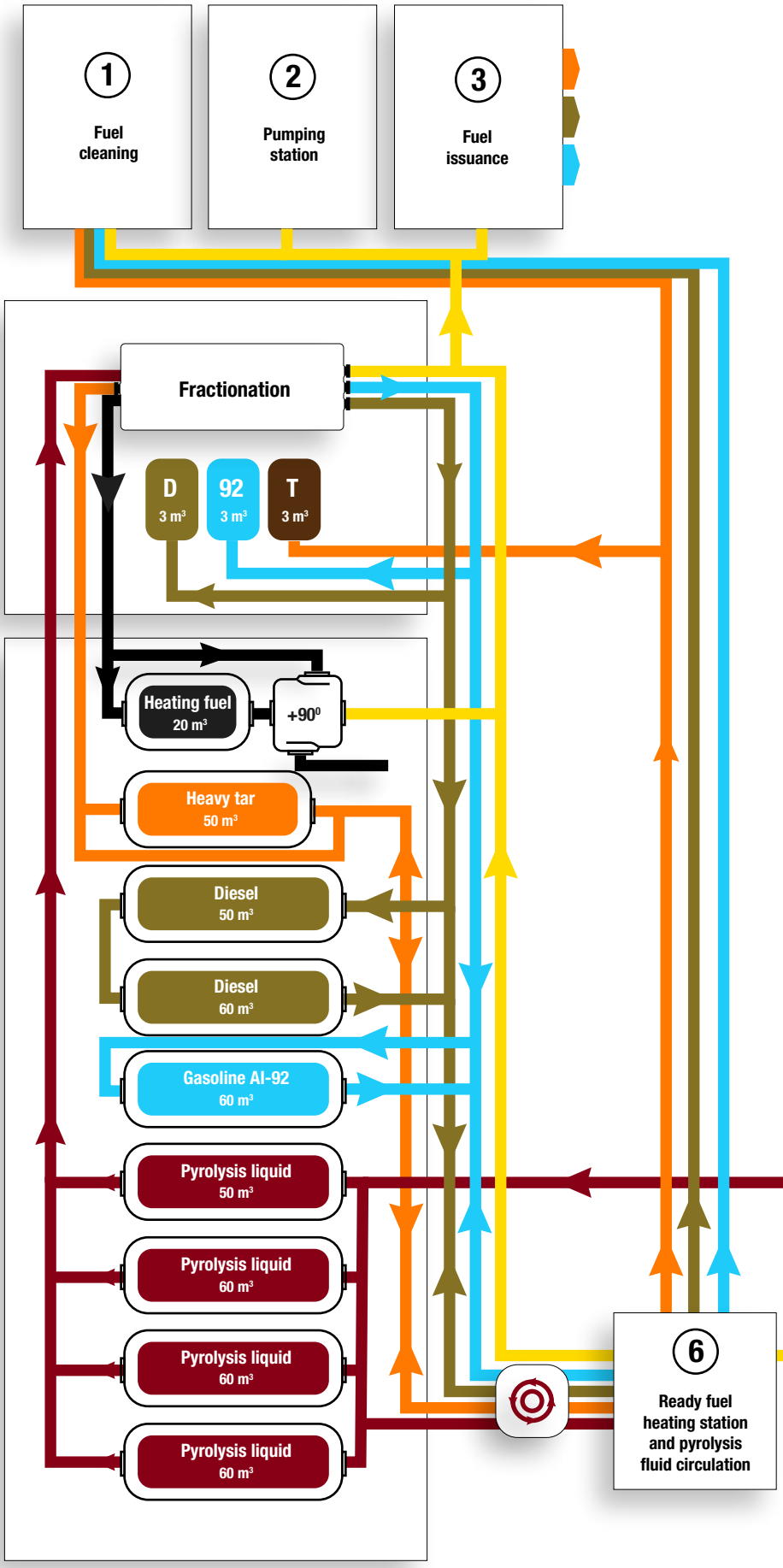
Block 10 - gas cleaning station.
Cleans gases from blocks 9, 4 to CO2.
The gases go to gas-liquid purification plants, which pass through carbon dioxide, which is dried and sent to block 11.

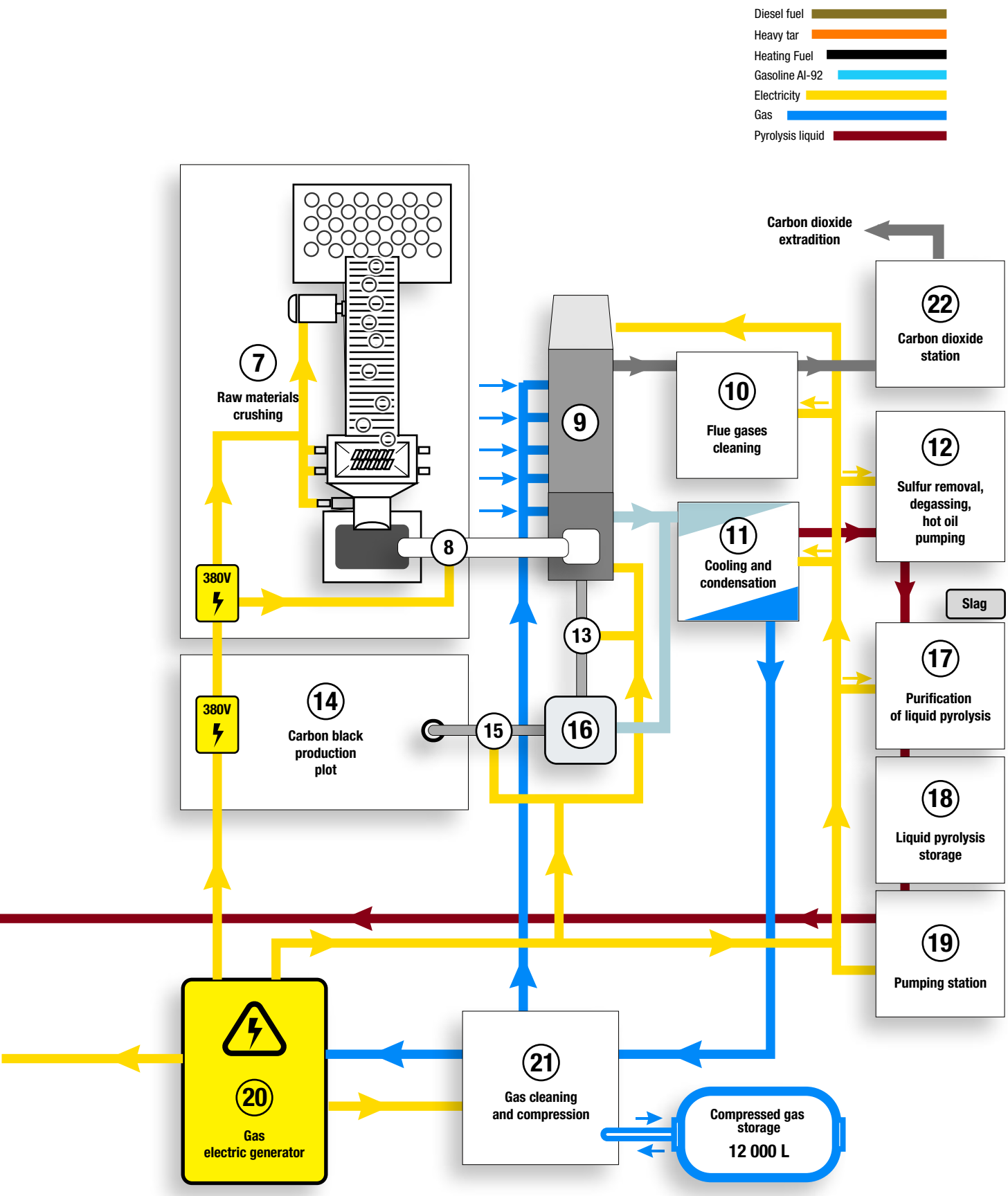
Block 11 - CO2 liquefaction plant.
Liquefies carbon dioxide, produces dry ice (optional), distributes liquid carbon dioxide in cylinders or containers.

Block 12 - Synthesis / Gas Cooling Unit and Condensate Removal.
It cools the wet synthesis / gas condensate from the pyrolysis reactor to precipitate, collects the condensate (pyrolysis liquid), pumps the condensate to plant No. 13 for degassing. Delivers the dried synthesis gas to plant No. 20 for purification.

Block 13 - Distribution Station.
The plant removes synthesis / gas residues from the pyrolysis liquid, heats the pyrolysis liquid, pumps hot pyrolysis liquid to the device 19 for purification.

Block 14 - technical / carbon hopper coming from the reactor.
The hopper supplies technical / carbon from the pyrolysis reactor. Teh / carbon is a recycling product.


1
Fuel cleaning
2
Pumping station
3
Fuel issuance
Fractionation
D
3 m³
92
3 m³
T
3 m³
Heating fuel
20 m³
+90⁰
Heavy tar
50 m³
Diesel
50 m³
Diesel
60 m³
Gasoline AI-92
60 m³
Pyrolysis liquid
50 m³
Pyrolysis liquid
60 m³
Pyrolysis liquid
60 m³
Pyrolysis liquid
60 m³
6
Ready fuel heating station and pyrolysis fluid circulation


Diesel fuel
Heavy tar
Heating Fuel
Gasoline AI-92
Electricity
Gas
Pyrolysis liquid
Carbon dioxide extradition
22
Carbon dioxide station
7
Raw materials crushing
9
10
Flue gases cleaning
12
Sulfur removal, degassing, hot oil pumping
8
11
Cooling and condensation
380V
Slag
13
17
Purification of liquid pyrolysis
380V
14
Carbon black production plot
15
16
18
Liquid pyrolysis storage
19
Pumping station
20
Gas electric generator
21
Gas cleaning and compression
Compressed gas storage
12 000 L

Block 15 - fuel storage pumping station, fuel processing facilities.
The plant supplies pyrolysis liquid unit No. 4 for fractionation, circulates and filters the fuel with a coarse filter, heats the fuel in the cold season, sends the fuel to the fuel purification equipment of the units 1, 2.

Block No. 16 - Power Plant.
Produces electricity for the needs of the processing complex. The fuel is compressed synthesis / gas. The power plant's fleet consists of one or more constant current GPES and one set of emergency diesel generators.

Block 17 - Synthesis / Gas Compression Station.
Pushes the incoming synthesis / gas to a pressure of 220 - 250 bar, stores some of the gas in high-pressure cylinders to restart the reactor, distributes the compressed gas supply to consumers: power plant, pyrolysis reactor.

Block 18 - Compressed Synthesis / Gas Storage.
It consists of a number of high pressure cylinders. Stores the compressed synthesis / gas reactor for restart.

Block 19 - final pyrolysis liquid treatment plant.
The plant maximally cleans the pyrolysis of liquid from soot particles and acidic compounds. The operation of the plant will significantly increase the service life of the following blocks.

Block 20 - Synthesis Gas Pretreatment Station.
Cleans synthesis / gas from possible mechanical impurities, toxic compounds.

Block 21 - Intermediate pumping station.

ECONOMIC INDICATORS
PYROLY-EKOPYR «EG-200»

Pyrolysis products per 1 day / 30 days:

• Pyrolysis liquid (density of 1 liter = 0.89 kg)	65/195 tons
• Carbon black	26/780 tons
• Combustible gas - the entire volume is used to keep the plant running	24/720 tons
• Process water – used in the production process	1,5/45 tons
• Gas consumption of the pyrolysis reactor	600 m³/hr

When fractionating a pyrolysis liquid, we obtain following results:

• Gasoline AI-92	25 – 30 %.	DENSITY AT 20° C, g/cm3	0,71 – 0,76
• DT Euro-5	45 – 50 %.	DENSITY AT 20° C, g/cm3	0,80 – 0,85
• Fuel oil M-100	12 – 15 %.	DENSITY AT 20° C, g/cm3	0,92 – 0,99
• Propane-butane -ethane gas	15 – 20 %.	50% used in the production	
• Heavy tar	5 – 8 %.	DENSITY AT 20° C, g/cm3	1,2 – 1,5

The calculation of the fuel amount is made at the minimum % values and the lowest possible prices.
Light and dark fractions, for 1 day / 30 days.

	1 day / 30 days	1 day / 30 days
• Gasoline AI-92	16,25 / 487,5 tons x 450 € /t	7 312 € / 219 375 €
• DT Euro-5	29,25 / 877,5 tons x 450 €/t	13 162 € / 394 875 €
• Fuel oil M-100	7,8 / 234 tons x 250 €/t	1 950 € / 58 500 €
• Propane-butane-ethane gas	9,75 / 292 tons x 200 €/t	1 950 € / 58 400 €
• Heavy tar	3 / 90 tons x 150 €/t	450 € / 13 500 €

Additionally, when processing rubber goods and plastics:

	1 day / 30 days	1 day / 30 days
Carbon black	30 / 900 tons x 250 € / t	7 500 € / 225 000 €
Steel wire cord	7 / 182 tons × 80 € / t	560 € / 14 560 €
Liquid carbon dioxide	28 / 840 tons x 230 € / t	6 440 € / 193 200 €

	1 day / 30 days
TOTAL AMOUNT PER DAY/ 30 DAYS:	**39 324 € / 1 179 720 €**

Payback period of the project (pessimistic scenario)	36 months after the launch
Manufacturing, installation and commissioning time	10 months
Design and georeferencing	3 months

HEAT AND ELECTRICITY GENERATION WITH THE COMPLEX «PYROLY-EKOPYR»

№	Complex name	Possible electricity production	Possible heat energy production
1	PYROLY-EKOPYR EG - 50	kuni 3000 кw/h	2 580 000 kCal
2	PYROLY-EKOPYR EG - 100	kuni 6000 кw/h	5 160 000 kCal
3	PYROLY-EKOPYR EG - 200	kuni 12 000 кw/h	10 320 000 kCal
4	PYROLY-EKOPYR EG - 500	kuni 30 000 кw/h	25 800 000 kCal
5	PYROLY-EKOPYR EG - 1000	kuni 60 000 кw/h	51 600 000 kCal
6	PYROLY-EKOPYR EG - 10 000	kuni 2 400 Mw/h	516 000 000 kCal

Uses of our equipment

Industrial waste (producers and importers of goods)

Mining and manufacturing.
Wastes from coal mining and beneficiation, wastes from water treatment of mines, wastes from crude oil and natural gas production, coal screenings, crude oil, natural gas and gas condensate, oil contaminated soil, waste removed from oilfield equipment.

Water companies and water treatment plants.
Sludges from biological treatment of household and mixed wastewater systems, wastes from stormwater and mechanical treatment of natural waters, wastes from sewage treatment plants (sludges), wells, wastes from mechanical treatment of oily wastewater, other wastes from industrial wastewater treatment.

Chemical and biological industries.
Wastes from the production of basic inorganic chemicals, polychlorinated biphenols, halogens, wastes from the production of mercury, wastes from the production of phosphoric acid, wastes from the production of sulfur dioxide, wastes from the production of hydrochloric acid, hydrochloric acid, acetylene.

Agriculture and wood processing industry.
Cereal waste, manure, waste from the fishing industry, obsolete mineral and organic fertilizers, slaughterhouse waste, logging waste, pesticides and agrochemical waste, low value wood waste, bark waste, natural wood chips, pulp production waste.

Landfills and recycling plants.
Municipal solid waste, construction waste for buildings, structures, asphalt and asphalt concrete pavement waste, tire waste, railway sleepers, construction and repair waste (garbage), electronic waste.

PYROLY®

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