

PRESENTS WORLD'S FIRST COMMERCIALLY VIABLE HIGH-SPEED PYROLYSIS ENERGY SYSTEM

MOBILE ENERGY PLANT OF HIGH-SPEED PYROLYSIS

green BLAZE



The ecology of the modern world is a very delicate, and day-to-day it is progressively exposed to negative influence of various spheres of human life. Unstable political and economic situation foster financial and structural crisis, which only worsen existed unfavorable picture. Amid increasing ecological threat, society should focus on achieving a balance between process use and environmental abuse. But unfortunately, the equilibrium is shifted to the latter more than ever.

The current industrial crisis is infrastructural, the applicable technologies are outdated and do not provide the required efficiency and economic performance. The crisis, affected all industrial spheres, is caused by the global struggle for possessing key energy resources.



Victor Uzlov M.E. (Engineering), MBA (Distinction) Managing Director & Chairman

The main vital theme is the problem of innovations in energy sector, which could essentially facilitate settlement of particular and general economic situations in the world. Many inventors offer remarkable ideas but its embodiment enormously varies from the initial project, that permits saying about the lack of any actual foundation and background.

We proudly introduce GREEN BLAZE – environmentally compatible effective mobile plant, capable of generating great amount of heat, power energy, and high-grade fuel from hydrocarbon waste. It is one of the best in the world in terms of specifications, functionality and new revealed opportunities in power energy generation and eco-friendly fuel. GREEN BLAZE fundamentally changes classical understanding of oil processing and product recovery. Besides, this is a brand-new technology of power energy and gas generation.

Singularity of the plant permits combining together such characteristics as small scale, great capacity, high durability and universality. GREEN BLAZE perfectly suits needs of cities and towns in purposes of utilization of waste and simultaneous generation of heat and power energy. At the same time, our plant embodies new era in the field of coal restoration directly on the site of its extraction. Restoration of raw material has never been so easy, ecological and beneficial!

The booklet was prepared specially for you — our dear partner! Its pages introduce you the full spectrum of competitive and inimitable advantages of GREEN BLAZE!

We are looking for Customers and potential partners for cooperation! Let's build safe and reliable environment together!

ADGEX BLAZE

MOBILE ENERGY PLANT	2
BASIC SPECIFICATIONS	4
FLAW DIAGRAM	6
ECOLOGICALLY-FRIENDLY	10
RAW MATERIALS	12
OPERATING PROTOTYPE	14
PLANT MODIFICATIONS	16
MANUFATURED PRODUCTS	18
DME SUBSTITUTES NATURAL GAS	20
HEAT GENERATION	22
PRIME COSTS	23
ON-SITE CONVERSION IN MINING INDUSTRY	24

green BLAZE MOBILE ENERGY PLANT

The plant is combination of generator and reactor of pyrolysis fluid, capable of producing electricity and highquality fuel with full processing of raw materials.

The mobile plant is ecofriendly and can be used in sensitive environment due to zero formation of harmful components.







COST EFFECTIVE ENERGY SOLUTION

At present, Energy Market offers various options for solving energy problems. However, very few of them are actually worthy. Comparing to other Energy technologies, ADGEX Blaze provides highly efficient technology of High-speed Ablative Pyrolysis able to continuously produce high-quality fuel, electricity, and heat.

High-speed Ablative Pyrolysis is a type of pyrolysis, when heat energy, supplied to the initial material, is conducted at high speed with no ingress of oxygen (or air mixture with oxygen).

This is enormous impact, as Pyrolysis Energy is considered a much more reliable form of renewable energy than solar, wind, or wave. Earlier prototypes of the invention have been tested during more than 15 years, until in 2014 the technicians-and-engineers of ADGEX Blaze have achieved sustainable construction arrangement of GREEN BLAZE. We have produced amounts of energy and fuel cost effective far in excess of other major designs to date.

GREEN BLAZE BASIC SPECIFICATIONS & MAJOR ADVANTAGES

- ✓ High capacity at low expenses and small size
- Energetically self-contained system
- ✓ Stability and independence of power energy generation process
- ✓ Technical maintenance without stoppage of operation
- Ecological Friendly
- ✓ Effective Logistics

Purity of output product enables to use the plant at any place of the world without any harm to ecology. The GREEN BLAZE performance has no climatic or seasonal dependence.

GREEN BLAZE is autonomous complex of equipment with finished closed cycle and with a great stability reserve. Exactly stability and non-dependence of processes are essential for distant regions, because it enables to supply heat and power energy to Customer even in case of equipment breakage. GREEN BLAZE is a brand new, high-performance and eco-friendly solution for your business!

FUNCTIONAL DIAGRAM OF GREEN BLAZE

GREEN BLAZE has a potential to become the world's first commercially viable HIGH-SPEED PYROLYSIS ENERGY SYSTEM



Key technical features of GREEN BLAZE plant are as follows:

- ✓ Ability to create continuous closed technological production process
- Minimal content of carbon monoxide with near-to-zero amount of CO2
- Output pyrolysis products are ecologically friendly due to the absence of bertinization process
- Minimal energy intensity as compared by other types of pyrolysis
- The process is followed by heat energy release (exothermic reactions outnumber endothermic ones)
- Manageability of the process's temperature modes, with ability (at certain conditions) to create "controlled synthesis of hydrocarbons" etc.



Prepared initial raw material, embodied as a slurry made of grinded brown coal or wood waste, is processed in reactor of high-speed pyrolysis with obtaining of liquid, gas products, and solid carboniferous remains (semi-coke). Noncondensing (gas) pyrolysis products are used as a fuel, stipulating the main process and generation of heat energy by means of combustion in waste-heat boiler.

Condensing (liquid) pyrolysis products are withdrawn from reactor and are subject to catalyst hydrocracking, by virtue of which amount of light fractions are increased. Obtained liquid represents synthetic liquid hydrocarbon fuel, which can be attributed to the grade of light heating fuels or diesel fuels. Semi-coke, remained after pyrolysis process is subject to utilization as a raw material for production of fuel pellets. Still residue, embodied as heavy resins and asphaltenes, is used for production of carbon slurry.

To provide heat mode of high-speed pyrolysis reactor, producer gas, generating in gas generator, is used. Raw material for the fuel gas is waste wood, semi-coke and other hydrocarbon wastes. Superfluous gas can be combusted in a boiler for generation of additional heat energy.



WOOD PREPARATION MODULE

Woodchipper DC-10 Receiving bin for woods Screw feeder with drive Cylinder dryer with drive

Screw feeder of dry wood with drive Mini-bin Wood grinder Bin for grinded wood Moisture meter Doser Pelleting press Cooling transporter



Bin for fuel pellets Screw feeder-doser with drive Chamber lock with boosting of carbon dioxide Gas Generator Hot cyclone with external heat insulation Heat exchanger gas-gas Smoke exhaust Intermediate gas storage Compressor Gas storage



The plant construction stipulates mounting of diesel-generation, powered by its own produced fuel - DME. Such option is capable of generating up to 1.2 MW of power energy directly on field for 1 unit of reactor.

The present GREEN BLAZE plant permits augmenting power for up 4 reactors at one time with existed gas generator and other plant's assemblies. Accordingly, maximum aggregate power can be up to 4.8 MW.





Heat-exchanger of the gas heater Carbon slurry dosing nozzle Isothermic reservoir High-speed pyrolysis reactor «РВСП-1» Hot cyclone thermally insulated Heat exchanger for air heating Condenser-hydraulic locking Gas boiler Tank for storage of liquid pyrolysis products

Pump for transfer of liquid pyrolysis products Catalytic reactor of mild cracking Diesel fuel tank Light fractions tank Bitumen fractions tank

MODULE OF CARBON SLURRY PREPARATION

Receiving bin of brown coal Track for unloading of brown coal Screw feeder for the brown coal bin Brown coal grinder Bin for brown coal after grinding Fine crusher for brown coal

Bin for the dust of brown coal Screw doser of brown coal dust Mixer-homogenizer Heating tank for bitumen Piston doser for bitumen Slurry cooler





GENERATION

5 items of diesel-generator

1 MBT WILSON P 1250

Or 1 item of diesel-generator

Instrumentation and controls

240 kW C330D5

Control panel



ECOLOGICALLY-FRIENDLY

Ecology and healthy prosperous future of our Planet are the key factors of ADGEX's business.

Gas generator structure is universal and unified and can be adapted for various types of raw material and customer needs. Ditry coal, Municipal Solid waste, Industrial & Commercial waste, Woodchip & Sawdust, Animal Manure & Fat, Food Residues & Oil, Sewage Sludge and other carbon-containing materials can be used as raw materials for Green Blaze.

We are committed to providing ecologically harmless technologies, which do not only preserve existing ecosystem, but also facilitate environmental remediation in whole.

We operate with oil spills, waste coal, household, rural, forestry and all the others hydrocarbon-containing waste. Our technologies enable to collect existing production wastes promptly and easily with subsequent restoration into envirosafe and highly beneficial products.

GREEN BLAZE is one of the most eco-friendly plant in the entire world. Apart of great power, capacity and reliability, reactor and all the component parts and assemblies have multiple protection level. Output products of the plant and the production technology itself are environmentally responsible. Operation process is carried out without formation of toxic and harmful substances, by-products of the plant are pollution-free, but even in spite of this fact, they can be re-recycled for the main production purposes.

Waste is stored, crushed, and GREEN BLAZE process is adopted depending on waste characteristics provides the reduction of landfill expenses, production of power generation, renewable energy certificates (RECs) and scrap metal from used tyres.





Operating prototype of GREEN BLAZE can utilize waste wood and brown coal as raw materials.

Reference tables of output product after thermochemical processing in conversion to 1 ton of initial material, in particular – waste wood and brown coal, are given below:

WASTE WOOD

Product output after processing based on temperature mode of reactor operation			
	520 °C	700 °C	830 °C
Liquid fraction (total amount), kg	300	450	220
High-carbon material, kg (semi-coke)	300	115	80
SYN gas, kg	115	200	415
Heat power, Gcal	1,8	1,2	0,7

BROWN COAL

Product output after processing based on temperature mode of reactor operation			
	620 °C	780 °C	930 °C
Liquid fraction (total amount), kg	140	240	160
High-carbon material, kg (semi-coke)	280	160	120
SYN gas, kg	80	100	220
Heat power, Gcal	1,6	1,0	0,4

GREEN BLAZE is mobile universal high-capacity energy plant of High-speed Ablative Pyrolysis followed by conditioning the pyrolysis products



Since the generating process of heat and power energy is completely uninterrupted and hinges on timely fuel supply, the stage of raw material preparation, i.e. grinding of wood with diameter of 40 cm and length of 50 cm. At that humidity of the wood has no any influence.



2 COAL

There is no any difference in quality and type of coal to use, because rotary crusher is used during preparation stage, and coal is crushed into a dust before its delivery to the reactor. It can be brown, thermal or coking coal. Obtained results and specifications are given for brown coal, since it is the cheapest one and the best available, however, in the event of usage of more qualitative energy coals, than process's characteristics will grow.

Economic part of the pyrolysis process is almost the same at usage of both wood and coal. In case of wood usage, initial expenses could be less, amount of ash residual is less as well (as compared by coal usage). However, troubles with procurement, storage and transportation of wood arouse. Considering this, the coal is the most optimal raw material in terms of logistics, nevertheless, additional bin is required for its storage.

The perfect way of GREEN BLAZE usage is directly on-site of coal deposit. At that, effectiveness does not depend on climatic of seasonal factors. Generation process of heat, power energy and high-quality fuel can be uninterrupted.





Technical specifications of existed GREEN BLAZE plant with single reactor are as follows:

Description	Magnitude
Max power of GREEN BLAZE with single reactor	1.25 MW
Certified power	1 MW
PRODUCTION:	
- heat energy	1,2 GCal/hour
- condensing hydrocarbons (no resin heating fuel of light fractions – DME)	250 kg/hour
Consumed raw material:	
- forestry wastes	250 kg/hour
- brown coal (dust of production wastes)	1000 kg/hour
Amount of personnel	16
- operator	3
- engineer of instrumentation and control	1
- number of shifts	4
Amount of energy consumed by the plant	250 KW
Voltage of three-phase current	400 V
Current frequency	50 Hz
Consumption of liquid synthetic heating fuel	
- for 1 item of Diesel-generator 240 kW Cummins C330D5	47 l/hour
- for 1 item of Diesel-generator 1 MW WILSON P 1250	250 l/hour





PLANT MODIFICATIONS

There are three plant modifications available, based on actual operating GREEN BLAZE prototype.

GREEN BLAZE - 1.25MW plant with single small reactor	
Max power	1.25 MW
Certified power	1 MW
Production of heat energy	1,2 GCal/hour
Production of DME	250 kg/hour

GREEN BLAZE - 5MW plant with four small reactors		
Max power of GREEN BLAZE with single reactor	5 MW	
Certified power	4 MW	
Production of heat energy	4,8 GCal/hour	
Production of DME 1000 kg/hour		

GREEN BLAZE - 38MW plant with single large reactor		
Max power of GREEN BLAZE with single reactor	38 MW	
Certified power	32 MW	
Production of heat energy	60 GCal/hour	
Production of DME 7500 kg/hour		

Each modifiaction occupies an area of no more than 200m².

38 MW variant provides two options for realization:

- \checkmark Traditional diesel-generator that is applied on effective industrial prototype
- ✓ EC-Turbine

The perspective method stipulates mounting of EC-Turbine, powered by heat energy, generating from incondensable (solid) products of pyrolysis.

EC-Turbine power plant is capable of generating power energy by means of utilizing superfluous vapor energy when it is supplied for technological needs.

EC-turbine has the following highlights as compared by traditional ways of power energy generation:

- High mechanical coefficient of efficiency > 99%
- Increased time between overhaul
- \checkmark High capacity, low leaks
- \checkmark Able to operate at revolutions up to 50000 rev/min
- Absence of additional synchronizers
- Low prime and manufacturing cost
- High power-weight parameters



GREEN BLAZE 38 MW is under technological tests and planned to be produced not earlier than in the middle of 2015.

EC-Turbine usage will be reasonable when the main performance of autonomous plant GREEN BLAZE is focused on generation of power energy. This solution perfectly suits for distant coal deposits, where production of power energy can be easily organized and transport it subsequently via power lines.





MANUFACTURED PRODUCTS

Three performance options of autonomous plants GREEN BLAZE depending on customer needs are offered:

- Production of power & heat energy
- Production of power & heat energy and liquid fuel
- Production of liquid fuel

HIGH-GRADE FUEL

GREEN BLAZEenables to produce high-grade fuel at low prime cost and minimal expenses directly on the field.



GREEN BLAZE can be re-configured to produce both fractions either diesel or petrol. Accordingly, the final product can be both heating oil and petrol or diesel. Combustion products are water and CO2. Produced fuel is not a greenhouse gas. Therefore it completely decomposed under the insolation. This high-quality ecologically friendly fuel of EURO-5 grade is a perfect alternative for traditional others types of fuels used over the world.

DISTINCTIVE ASPECTS are:

- High-quality eco-friendly fuel
- Easy storage / transportation (containers, cisterns, pipeline)
- Easy upgrade of Internal Combustion Engine to be powered by DME
- Improvement of noise characteristics of Internal Combustion Engine with preservation of power and capacity parameters

Dimethyl Ether



Dimethyl Ether (DME) is synthesized during the operation process of GREEN BLAZE. DME is close to liquefied natural gases (propane, butane) and stored in low-pressure balloons.

In case of usage of DME, internal combustion engine is to be upgraded with special fuel facilities. As per data of principal world engine manufacturers, usage of DME in diesel engines leads to lowering of exhaust gases toxicity to the standard EURO-4. Noise characteristics are improved with preservation of the power and efficiency. A growing number of the world's auto manufacturers are starting to use DME as an alternative and ecological type of fuel.

GREEN BLAZE is available to continuously produce electricity, heat, and high-quality fuel.

Fuel specifications	DME	DIESEL
Molal mass C _n H _{1,8n}	46	190220
Mass amount of chemical elements,%:		
- carbon	52,2	86,6
- hydrogen	13	13
- oxygen	34,8	0,4
Coefficient of compressibility actual at 20ºC and 0,1 MPa, 1/Pa	157*10 ⁻¹¹	67*10 ⁻¹¹
Density of liquid phase at 20ºC, kg/m³	668	831845
Kinematic viscosity (fluid, 20ºC), mm²/s	3	0,23
Surface-tension coefficient, N/m	0,0012	0,028
Water solubility at 20ºC, kg/m³	70	-
Pressure of saturated steam at 20ºC, MPa	0,53	0,0008
Boiling temperature (liquefaction) at 0,1 MPa, 20°C	-24,8	180371
Critical pressure / temperature, MPa/K	5,37/400	-
Vaporization heat at 20ºC, kJ/kg	410	210250
Lower calorific capacitance, MJ/kg	28,84	42,5
On-board energy storage, MJ/l	18,9	35,9
Cetane rating	>55	4055
Stoichiometric ratio l _o , kg/kg	9	14,56
Self-ignition temperature, °C	235	240310
CO ₂ exhaust at complete combustion, g/MJ	67,5	74,2



DME's physical properties are very similar to LNG (Liquefied natural gas). At the same time it has incontestable technological advantages. Thus, DME can be a perfect alternative of LNG as motor oil, gas turbine oil, in household usage. DME has a greater liquefaction temperature (– 24,5°C) sa compared by LNG, thus it can be stored in the same reservoirs as LNG. Only water and CO₂ are originated during its combustion, no soot. Calorific capacitance of DME (28,4 MJ/kg) just a little less than specific combustion value of LNG.

Besides, DME is used for production of spray paints and in perfumes, since it is a great solvent and propellant at the same time, at that it is completely decomposed in atmosphere (not a greenhouse gas, like methane).

Important benefit of DME is possibility to deliver in containers, balloons and cisterns directly from producer or receiving terminal to gas stations or personal (household) communal services of customers. At that, distribution costs are reduced.

Transportation of DME is feasible in containers and lighters. Thus, DME is not a mere transport technology; this is a ready product for customers (bottled DME). DME has a high cetane rating that permits using it as effective diesel fuel.



21



Existed vehicles are ideal for DME distribution to customers in both household and communal services

Existed infrastructure of LNG storage can be adopted for DME storage.



HEAT GENERATION

Heat energy is a side product and can be used for heating of living and industrial facilities.

In order to provide heating mode of the high-speed pyrolysis reactor, producer gas, generated in gas generator is used. Producer gas in required amount is forwarded to gas-fired boiler, where it is combusted for generation of heat energy.

During production of heat energy, vortex method of gas generation with afterburning of producer gases and coke, obtained during the process of highspeed pyrolysis with usage of mixer-cavitator, which permits using heat energy of chemical reactions to the full extent, is used in GREEN BLAZE plant. Pyrolysis fuel, accumulated during the operation of low power gas generator and reactor, is a perfect free-burning raw material for generation of heat energy with high grade of calorific capacitance and can be reserved for a long period. In case of necessity, for instance in wintertime, it gives additional reserve of heat energy and permits carrying out maintenance works without stoppage of energy generation.

Matchless advantages of GREEN BLAZE

Matchless advantages of GREEN BLAZE, using as heat generation plant:

- ✓ Very low CAPEX & OPEX
- Small size;
- Absence of polluting emissions and minimum amount of ash wastes
- Full plant autonomy at operation mode
- Provision of uninterrupted operation due to continuous storing of liquid fuel
- Feasibility to position directly on heat pipeline

From the point view of heat and power energy generation, manufacturing factories on the basis of solid-fuelled steam boilers and steam turbines with electric generators can be considered as analogues of GREEN BLAZE plant. The feature of steam turbine power plant is that steam shall be supplied to turbine under a high pressure (from 13 atm. at 190°C and up to 240 atm. at 550°C). Such conditions specify higher requirements to boiling equipment that leads to significant growth of capital investments.

Serious disadvantages of the effective steam turbine plants, producing heat and power energy are losses of a great amount of heat due to regeneration limitations, caused by features of cold steam, high noise level, big size, complexity, low reliability and expensiveness. Heat losses in modern steam boilers reach 60% that is stipulated by incomplete fuel combustion (in particular coal), resulting in considerable pollution of environment by the incomplete production products and remains underburned coal. Offered autonomous complex GREEN BLAZE does not require great capital investments, at that it is characterized by low OPEX.

Actual prime cost of liquid fuel made of brown coal on GREEN BLAZE plant with single reactor.

DIESEL FUEL PRIME COST	
Production of 5 tons per day (consumption of 10 tons of initial material)	0.22 \$USD/L
Production of 10 tons per day(consumption of 20 tons of initial material)	0.14 \$USD/L

DME PRIME COST		
Synthesis of 3 tons per day, (consumption of 9 tons of initial material)	0.14 \$USD/L	
In case of plant's capacity augmentation, each successive ton of DME will cost by 5% less in average		
Prime cost lower point of 1 liter DME	0.11 \$USD/L	

Actual prime cost of power energy from brown coal on GREEN BLAZE plant:

POWER ENERGY PRIME COST:		
Production of 1kWh USD \$0.046		
OPEX, not more (at output power 1 MW of power energy)	USD \$0,53M/year	

green BLAZE ON-SITE CONVERSION IN MINING INDUSTRY

On-Site Conversion Technology is a brand new, high-performance and eco-friendly solution for mining industry!

Pyrolysis of Coal – conversion of coal (any fraction size of any type of coal) into a ready product (highest eco-fuel & electricity) from worse quality and crashed coal.

Get finished product straight on the site of extraction. No need to transfer coal to any processing plants any more – all stages of production process are conducted at one place. It has never been so easy to restore raw material into a ready-made product!

Conversion into various energy by-products, namely Bio-Diesel, Bio-Petrol and Bio-DME & Electric Power can boost unexpected major profit, derived from coal rocks. No need to haulage coal to any processing plants any more – all stages of production process are conducted at one place.

It has never been so easy to restore raw material into a ready-made product! No more need to build costly infrastructure for extraction and transportation of coal. Any quality coal and crushed fraction become the best raw base. Miners can easily obtain ready product straight on the tenement.

Feedstock is processed under highly controlled conditions using our Hi-speed Green Blaze technology, resulting in minimal air pollution and remarkably high gas yields. Any polluting elements are safely extracted; our plants has no toxic air emissions. All by-products are re-used in the process.

On-Site Conversion Technology is a brand new, high-performance, lucrative and eco-friendly solutions for mining industry!





Offered autonomous complex GREEN BLAZE, powered by slurry made of brown coal and waste wood, provides simultaneous generation of power and heat energy, and eco-friendly liquid fuel.

Availability and cost-effectiveness of raw material

- Usage of technical wastes of forestry and coal dust, and other hydrocarbon wastes
- Quality and humidity of initial raw material has no importance

Economic effectiveness

- Complete processing of coal or any other raw material
- ✓ High coefficient of efficiency
- Low energy consumption
- ✓ High service life of aggregates
- Technical maintenance without stoppage of operation

Ecological sustainability

- Zero formation of harmful components
- Eco-friendly mobile plant can be used in sensitive environment
- High-technology production process is closed and continuous, that enable generation for a long time even in case of the lack of initial raw material

Production effectiveness and reliability

- Energetically self-contained system, resulting in simplicity in maintenance
- ✓ Automated control system no need of a great number of personnel
- Small size and high capacity of singular reactor of high-speed pyrolysis
- Stability and independence from power energy generation process
- Light construction, serviceability and interchangeability of modules
- High level of durability



- Easy way of storage and transportation of a liquid fuel, embodied as production product with ability to obtain high-quality motor fuel (EURO-5)
- Transportation of electricity via power lines from the production spot to customer
- ✓ Ability to place the plant directly on the site of heat supply to a heat pipeline



ECOLOGY ENGINEERING MACHINERY

ADGEX LIMITED (ACN 156 556 035) SUITE 701, LEVEL 7, 53 WALKER STREET, NORTH SYDNEY, NSW, 2060, AUSTRALIA

> TEL.+61 416 377 950 FAX +61 2 8003 9725

INFO@ADGEX.COM WWW.ADGEX.COM

TAKE ADVANTAGE OF OUR TECHNOLOGY!

