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The Concept of the Energy Hub on the Site of an Old Mine in the Donetsk Region

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Inevitability of the Closing Process the Donbass Mines

- Coal in the Donetsk Basin, located on the territory of Donetsk, Luhansk and Dnipropetrovsk regions, began to be mined in 1723.
- In 2013, 122 mines were operating in the Donetsk Basin. In 2014, there were 94 mines on the territory occupied by Russia, 67 of them had already been closed before the start of the full-scale war.
- In 2020, 28.8 million tons of coal were mined in Ukraine, of which only 10% was obtained at 29 state-owned mines. In 1990, 220 state-owned mines produced 220 million tons of coal
- Today, only 12 state-owned mines are operating in the unoccupied part of Donetsk region, which mine about 4 million tons of coal, which is uncompetitive on the market. Therefore, state mines receive the billions of UAH in subsidies.
- Ukraine is planed during next 10 years to decrease coal production and graduated closure of coal mining and relative enterprises

Donetsk Mine

- Mine is an enterprise that carries out the extraction of reservoir minerals underground and shipment to the consumer or to the enrichment enterprise.
- The mine includes surface (copra, above-mine buildings, main fan units, crushing and sorting factories, boiler house, warehouses) and a set of underground mine workings intended for the development of the field within the mine field.

The main buildings and structures of the surface complex of "Pokrovske" Mine Enterprise (Donetsk Region)

Coal mine as a large power consumer

- A coal mine is a large consumer of electricity. The electric capacity consumed by all the mechanisms of one mine ranges from 7 to 30 MW.
- In 1991, the Ukrainian coal industry accounted for more than 20% of all electricity consumed.
- The main consumptions of electricity are related to the need for constant pumping of groundwater (up to 20% of electricity consumption), power supply of underground and ground electrical mechanisms and transport, power supply of air compressors, etc.

Transformation of Coal Enterprise

- After the mine are closed, the problem of pumping out the mine water remains, and local authorities at least need to find sources of funding for such activities.
- In order to provide thermal energy to the population and communal services of mining towns, it is necessary to preserve mine boiler houses, and modernize them for new types of fuel using
- The best solution would be to turn the mine into a facility of various types of renewable energy, as a powerful power line enters the mine.

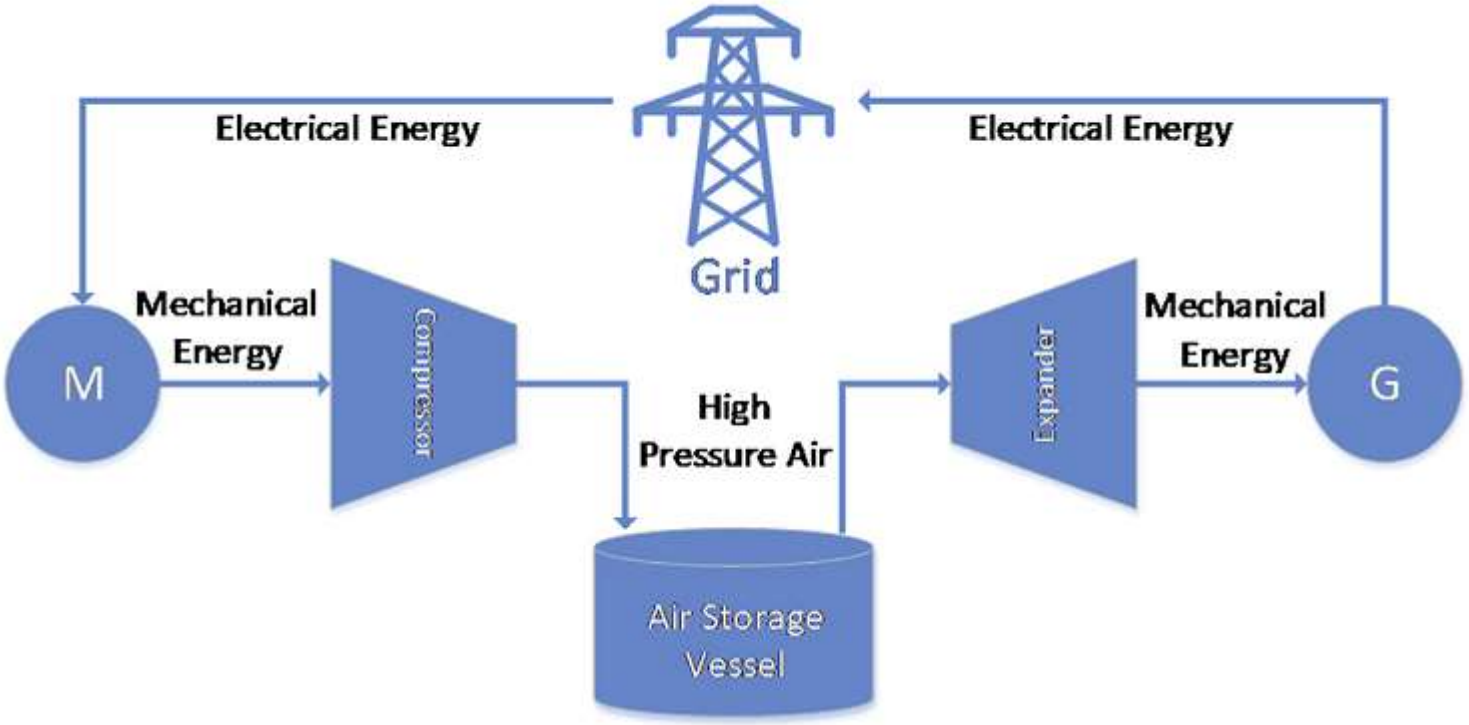
Mine Energy Conversion

We proposed the conversion of the mine into an energy hub. Donetsk mines have a great depth - up to 1,600 m. For air ventilation and power supply of pneumatic devices, powerful compressor units, are used. The consumed electric power of which exceeds a several megawatts.

This makes it possible to consider the mines as potential compressed air energy storages, when they are pumped with compressed air when there is excess electricity in the power system. When it is needed, the compressed air is expanded in a gas turbine and the electricity is produced. The efficiency of this process is up to 65%, which corresponds to the efficiency of existing pumped-storage hydro power plants.

Part of the generated electricity can be used to pump out contaminated mine water, which can become a source of water for the population and utilities after treatment. In this way, complex environmental and social problems will be solved.

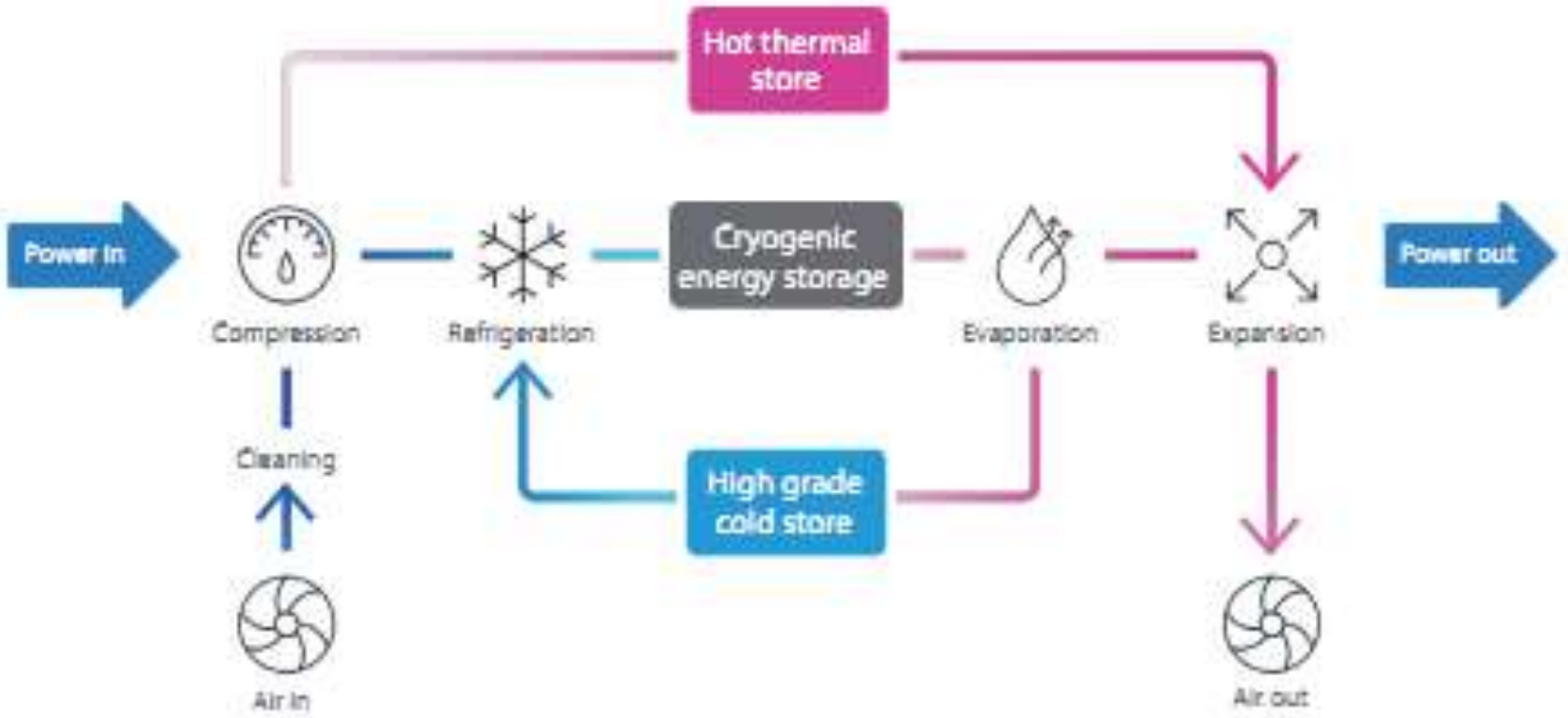
Compressed Air Energy Storage system with energy flow.



Advantages:

Long time of storage
Zero pollutant emissions
Storage pressure of air is up to 100 bar
Simple process scheme

Liquid Air Energy Storage Process



Advantages:

Long time of storage
Zero pollutant emissions
Storage pressure of liquid air is atmospheric
Gas pressure after extension is 700 bar

Oxygen Gasification of Waste + Compressed Air Energy Storage

Our know-how is the joint use of energy storage with an air separation unit to obtained the oxygen. The O2 is planned to be used as a gasification agent in gasifiers for high-ash content coal waste, biomass, municipal and industrial waste.

Syngas with an average lower heat value of 10 MJ/m3 will be produced, which can be used in steam boilers and gas engines based on mine boiler houses for decentralized production of electrical and thermal energy.

When using compressed nitrogen and argon for energy storage and electricity generation, such a complex will have a guaranteed surplus of electricity produstion during the day.

Air Separation Unit

Target:	Oxygen separation and storage
Technology:	Adsorption Oxygen Plant
	Cryogenic Oxygen Plant
	Membrane Oxygen Plant

THERMOSELECT Resource Recovery Process

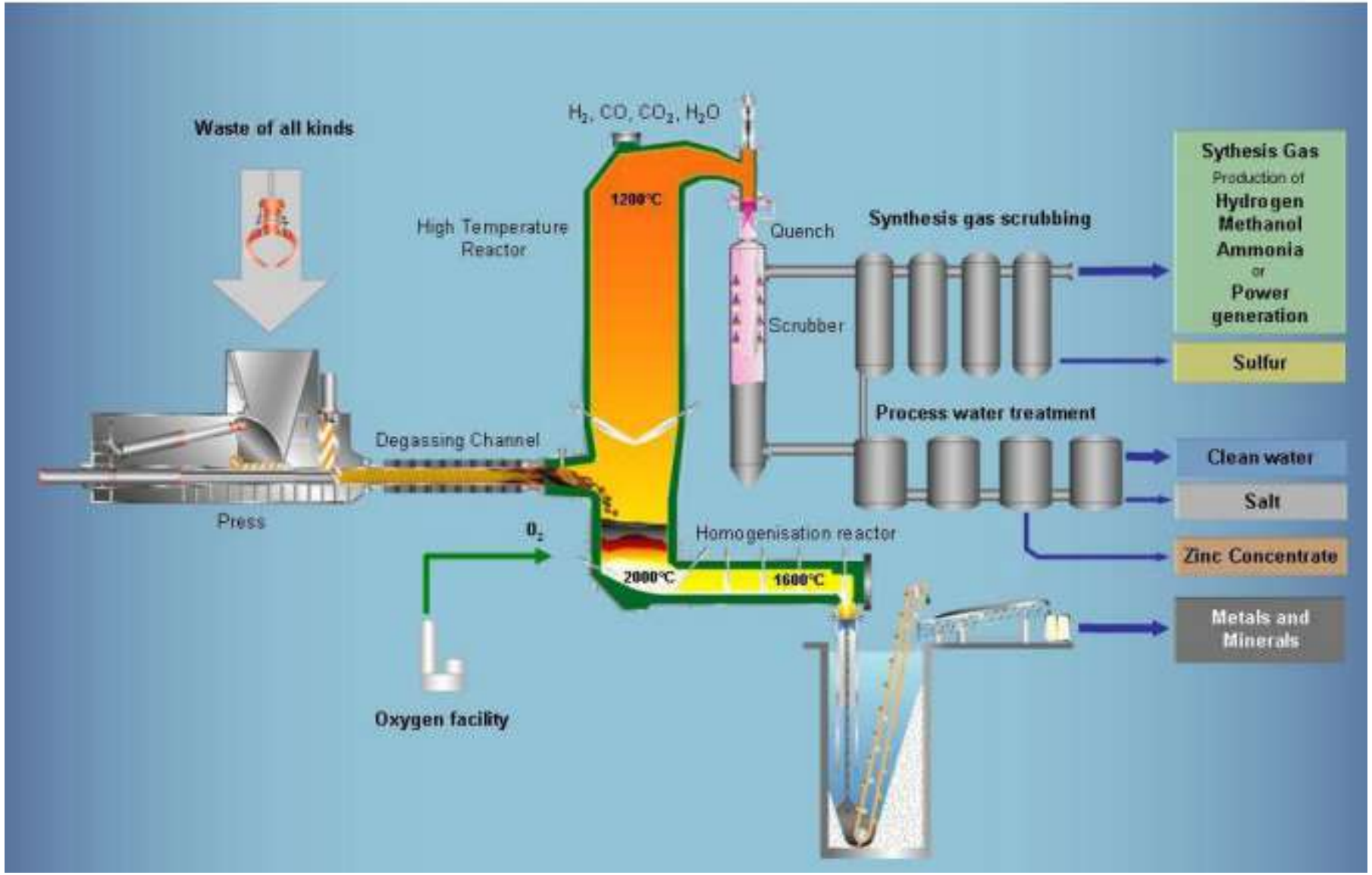
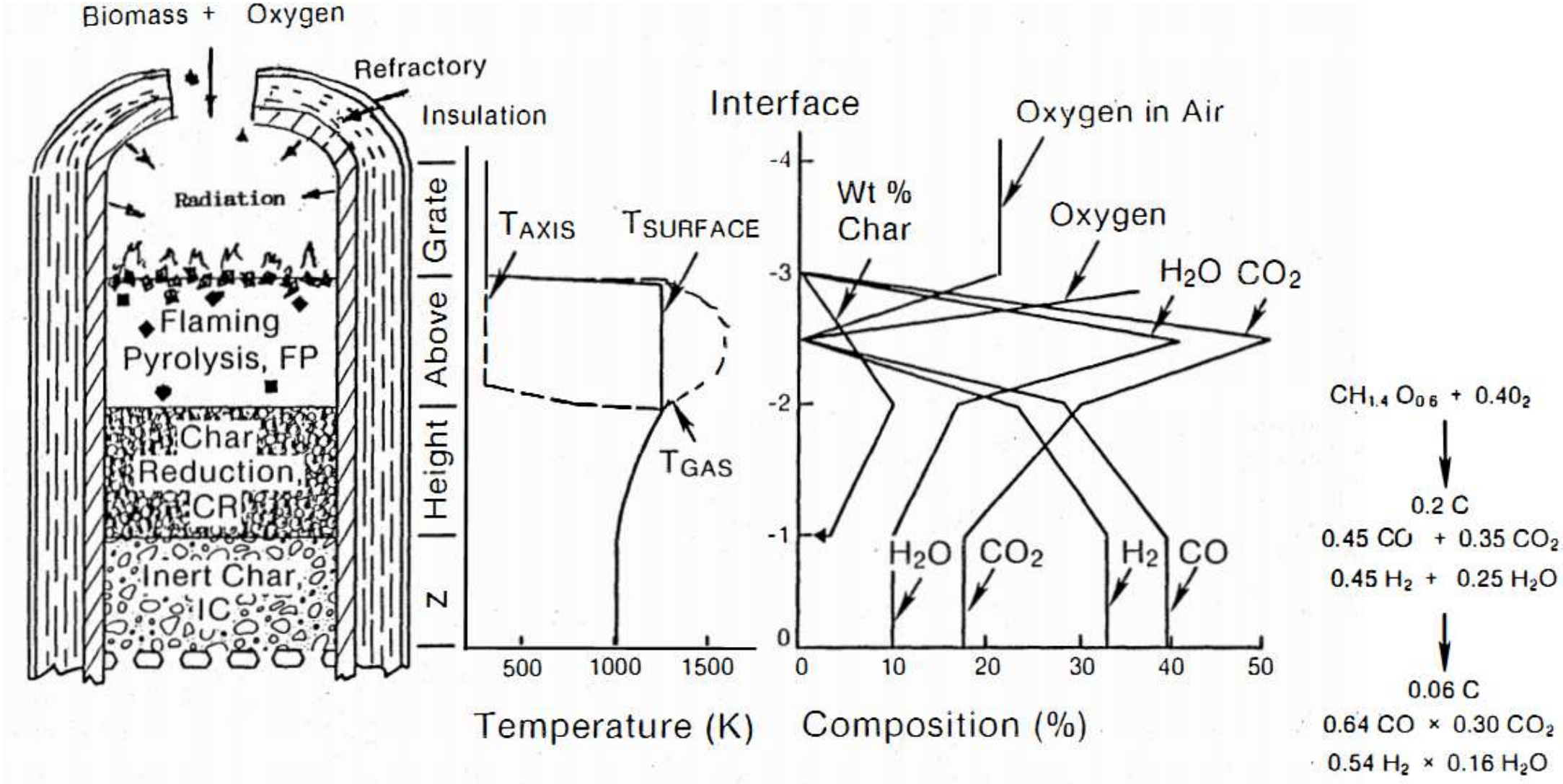


Diagram of Zones in an Oxygen Fixed Bed Downdraft Gasifier



Thanks for your attention!

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