



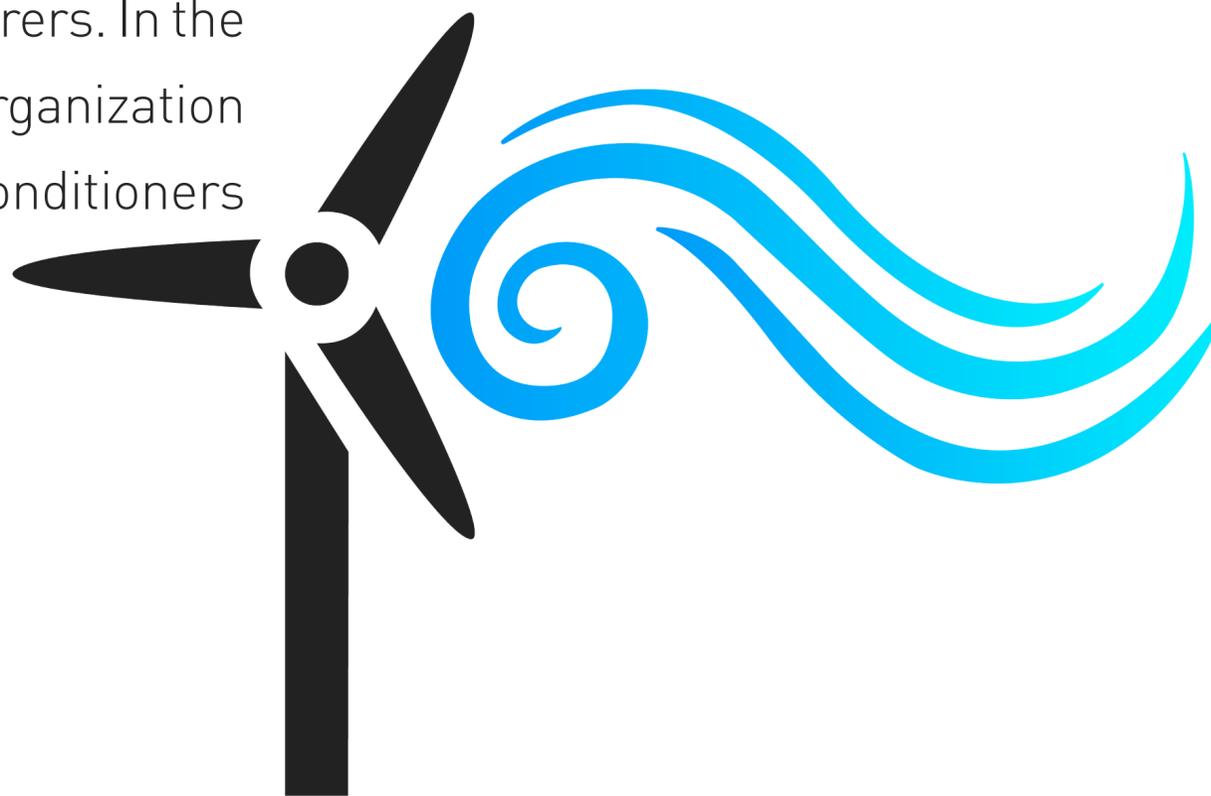
COOLANT

Any computational process requires powerful technical equipment, which, despite the range of advantages has one major drawback. The overwhelming majority of electronics in the world is cooled by one of the most common, and at the same time, ineffective types of coolant - air. And if humankind has advanced significantly in the supercomputers development, approaches to cooling are actually stuck in the 80s. of XX century.

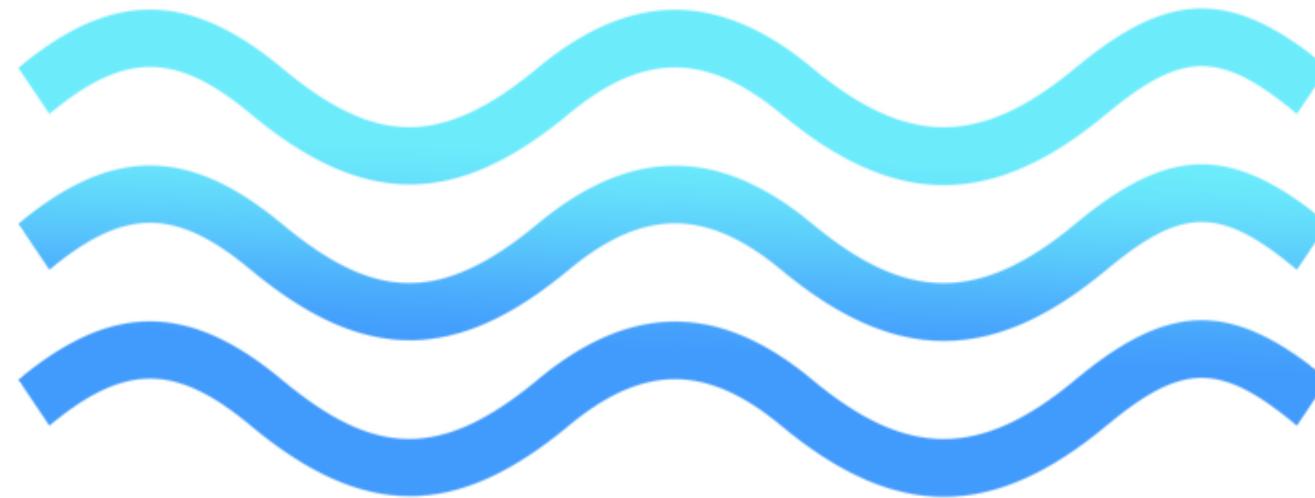
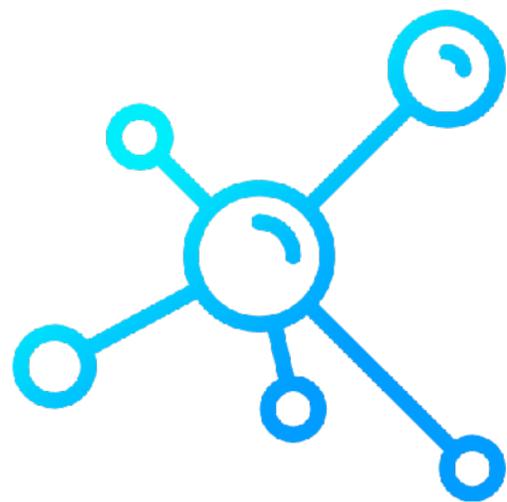
Most miners use a regular air cooling, as there is no any provided alternative from manufacturers. In the best-case scenario, we can talk about organization of cold corridors and installation of air conditioners for additional cooling, but that is it.

For example,

to remove heat from a mine with a power consumption of **100 kW**, you have to provide it with **30,000 cubic meters** of air per hour. This leads to the fact that all “air” solutions become inefficient, affect the working conditions of the equipment, reduce its lifespan and increase payoff period.



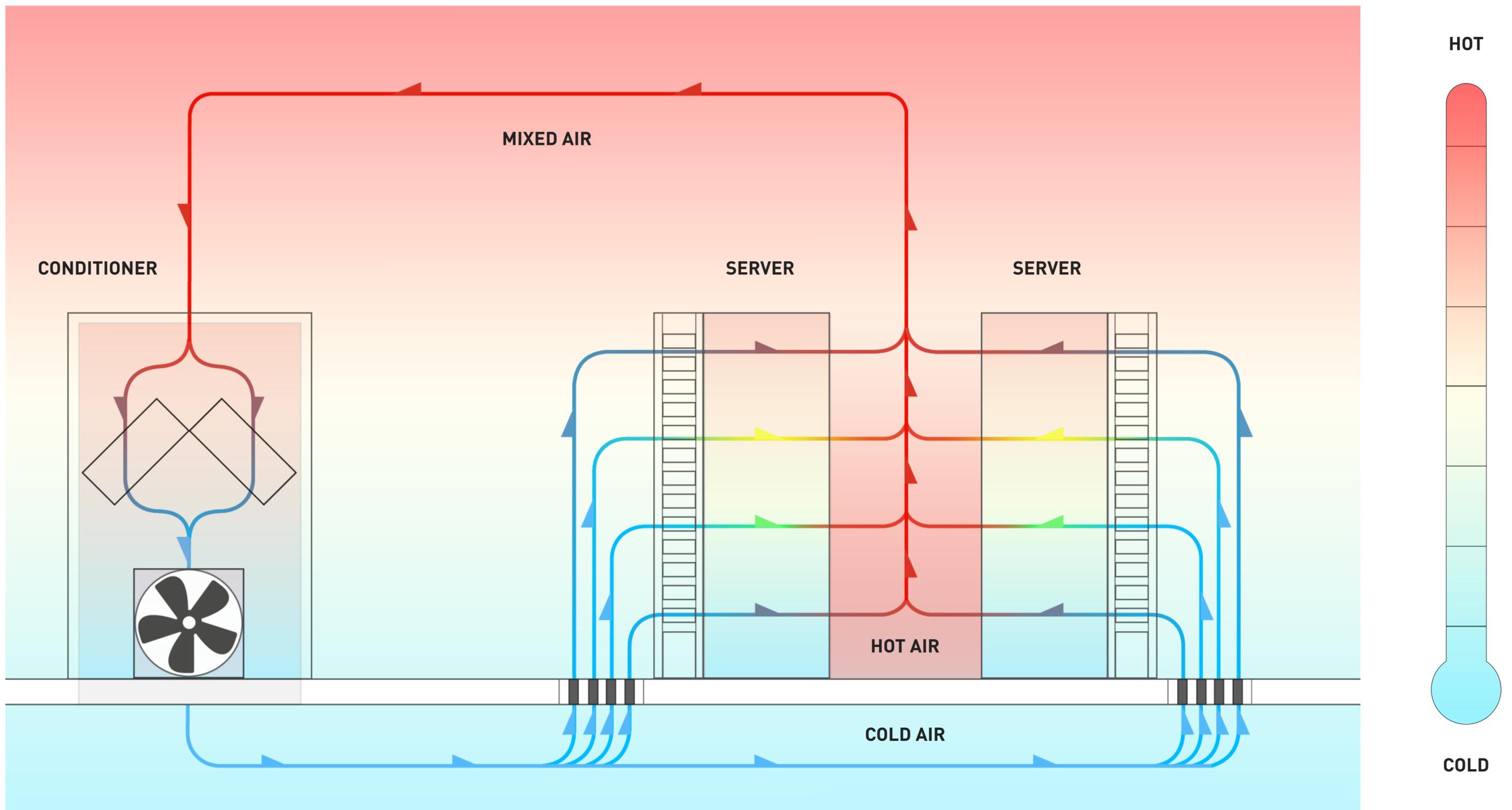
BUT NEW ERA IS COMING



THE ERA OF IMMERSION COOLING

WHY

AIR COOLING IS NOT SUITABLE FOR MINING CLUSTERS



Scheme 1. Traditional air cooling

If operation of small devices doesn't require special cooling measures (e.g. a tablet or PC is cooled by passive or active air cooling, respectively) powerful devices with large heat output, which operate at maximum performance 24/7 a year, definitely need an additional cooling system to prevent overheating.

Overheating is the most common reason of computing equipment failure. Excess heat leads to unstable operation of the system, exceeding the threshold of standard temperatures and **MAY CAUSE a SHORT CIRCUIT AND FIRE.**



THE AMOUNT OF GENERATED HEAT DEPENDS ON SEVERAL FACTORS. Heat proportionally increases with the equipment operating time, heating surface enlargement and heating element temperature elevation.

Heat exchange rate
depends on the following **FACTORS**:



density

specific heat
capacitance

thermal conductivity

dynamic
viscosity coefficient

thermal diffusivity

AIR, being the most common element of a cooling system, is absolutely **NOT SUITABLE** for large mining clusters for a number of reasons:

1
Air cooling catalysis dust accumulation. It remains the inevitable satellite of electronics, as exists in all rooms, in any climatic conditions and anywhere in the world. It conducts static electricity, which can damage equipment components while operation.

2
Mechanical moving parts of coolers fail more often, especially when operating 24/7. This usually occurs within 1-1.5 years.

3
Low level of the equipment placement density in the air cooling system. Such approach requires cold and warm corridors organisation, which leads to the fact that A 10-foot sea container can accommodate 2.5 times less ASIC units and 6 times less GPUs than, for example, in case of immersion cooling.

4 Air cooling doesn't imply serious equipment overclocking. Liquid cooling does.

5 High external temperatures lead to the performance reduction. This requires additional cooling system, which means extra costs on its implementation.

6 Everything that works on air cooling creates additional background noise. One ASIC, for example, generates 75 dB.

7 Considering the costs on repair, maintenance, additional electricity consumption and assembling raised floors panels system in the perspective of three or more years, air cooling is more expensive than any analogue based on liquid / immersion cooling

WORLD EXPERIENCE

OF LIQUID COOLING



Due to the high density level of liquid, manufacturers tried to use it for cooling complicated technical devices. Combination of electronics and liquid is not the best option, as water is a conductor which causes corrosion of elements with time. Cooling circuit violation leads to the electronics failure. Therefore, many companies have refused to use any liquids to avoid a possibility of leaks.

Such approach is not correct, as it is possible to create unique liquid content, which will be suitable for immersion cooling. Only a few companies use liquids for cooling their equipment today.

Intel

Since 2014, the worldwide-known manufacturer of computer hardware uses liquid developed by 3M for immersion cooling for their supercomputer. It is called Novec and serves as proof of efficient usage of immersion cooling with electronics. The solutions applied in SGI Ice X brought the idea to increase the density of the equipment accommodation without losing characteristics.

3M

It is one of the most popular companies-manufacturers of liquids for immersion cooling and systems developed on its basis (such as BitFury). 3M products are used in both single-phase and two-phase cooling systems. A distinctive feature is the incombustibility and high flash temperature, as well as the thermal stability required when using two-phase circuits.

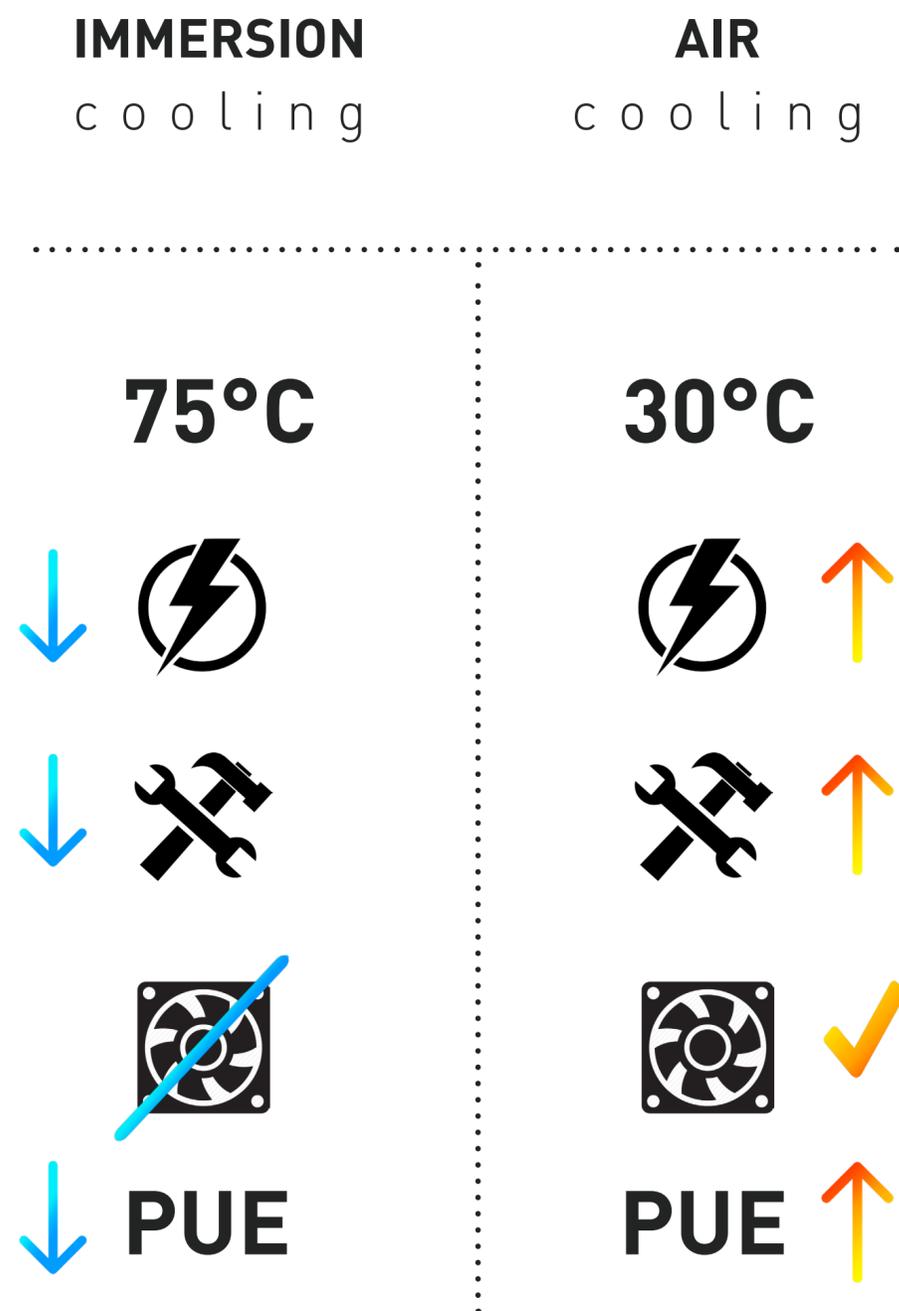


INNOVATIVE APPROACH lies in selection of the appropriate coolant, tested by experts. Dielectric properties and inertness to all system components are the main requirements.

ECOLOGY OF PROCESS

In present days, the pursuit of a cheap electric power has led to concentration of miners mostly in countries with lower environmental standards. Electricity is produced there using fossil fuels. Thus, mining indirectly influence on the climate change, due to the increased demand for electricity and increased levels of CO₂ in the atmosphere. This process can be changed by using immersion cooling technology.





The main reason why immersion cooling is cheaper than air cooling is temperature differences between the coolant and the equipment, so there is no negative impact on the electronics performance. In other words, effective equipment cooling is possible even if the coolant heats up to 75 °C, while the optimal temperature of air cooling systems is only about 30 °C. Additional savings are achieved by dismantling stock fans, since they aren't no longer necessary with immersion cooling. This saves about 5-10% of energy consumption, depending on the type of equipment.

In recent years, manufacturers are studying the ways of how to reduce the so-called “carbon” footprint.

FOR EXAMPLE

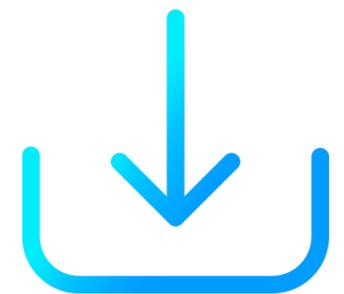
In the United States, about 450 g of carbon dioxide emissions account for 1 kW / h of electricity consumed. This is related to the fact that the average level of PUE (energy efficiency) of a modern data center is 1.2-1.3. It is calculated by the formula:

$$\text{PUE} = \text{Total facility power} / \text{IT equipment power}$$

While systems with similar computing powers based on immersion cooling already demonstrate a PUE level of ~1.09.

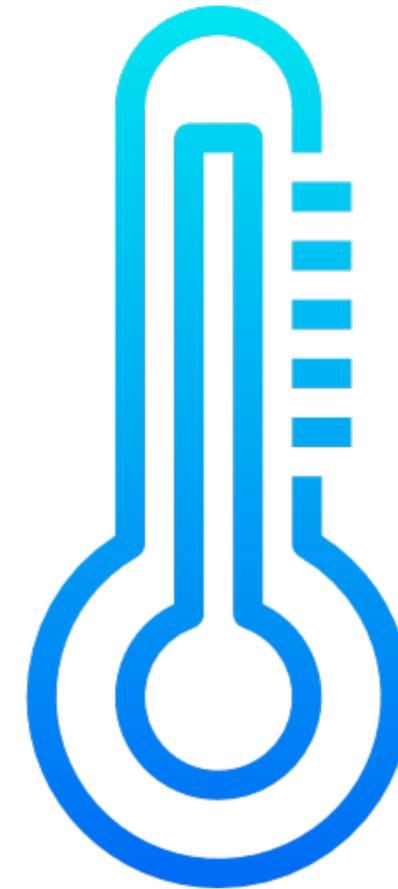
IMMERSION COOLING

None of existing developments in the field of equipment cooling can demonstrate the same level of efficiency as immersion cooling. It has been known for about 100 years, but the search and creating the ideal coolant still continues. The thing is that the interaction of liquids with modern electronics isn't studied good enough and it is not recommended to just immerse equipment in unknown liquid. Ignorance of the liquid characteristics and properties, as well as the peculiarities of interaction with electronic equipment can lead to dire consequences.



With immersion cooling, heat is evenly removed from the entire surface of the equipment, not just from the hottest spots. Thus, the thermostatics of the electronics is maintained in the required temperature range. It is determined by characteristics of the equipment and overclocking potential. Unlike air, the coolant temperature values can be much higher and aren't supposed to approach minimum values.

The concept of cooling system efficiency can be explained using the example with a central processor. A processor loaded at 100% with an ambient temperature of 32 ° C shows an average temperature of 85 ° C. At the same time, video cards operate at 65–75 ° C, while ASICs operate at 85–70 ° C with a coolant temperature of 60–70 ° C.



THIS MEANS that even if the temperature of the liquid is higher than air, the temperature of the equipment is still lower than with air cooling.



COOLANT FUNCTIONS

Coolant is the main component of immersion cooling. Compatibility with all components of the system that are in contact with the coolant is a fundamental principle when choosing the type of liquid.

THE BENEFITS OF USING A PROPER IMMERSION LIQUID

 **PERFORMANCE** of the equipment increases by 20-40%, depending on the tasks. It is achieved by raising video cards frequencies while maintaining thermal stability.

 **SAVINGS** per 1000 video cards, considering a power consumption of 6 W per set of coolers, will be more than 3,700 kWh per month. For 200 ASIC devices the economy will be almost 10,000 kWh per month.

 **THERMAL CONDUCTIVITY** of a liquid is 4.5 times higher than air.

 All components of the equipment are cooled evenly so **THERE ARE NO** overheated spots.

 **THE VOLUME** of required coolant for cooling the equipment per kg is much less than the same volume of air (approximately 1000–1500 times, depending on the air characteristics).

 **IMMERSION COOLING** protects the equipment from dust and debris, which often lead to overheating and failure. Dust accumulations can cause the system instability as it conduct electric current. In addition, as there is no need to turn off the equipment in order to clean it, the equipment downtime is drastically reduces.

 **LOW LEVEL OF NOISE.** Before immersion, coolers, which are the main source of noise, are dismantled from the equipment.

 **LIQUID DOES NOT DEGRADE** the components of the installation (pipes, motherboards, radiators, chips) and does not lead to its corrosion.

 **NO NEED** in replacing consumables such as filters and coolers with immersion cooling system.

 **THE LIQUID IS NONTOXIC**, eco-friendly and safe for people and animals.

 **EQUIPMENT CLEANING** from the immersion liquid can be performed by the help of ultrasonic bath.

IMMERSION LIQUID SELECTION

Currently, developers of liquid cooling system are testing both mineral and synthetic liquids. However, choosing a suitable option in the market is tough. Not many immersion liquids possess the desired properties and are compatible with mining equipment. Rushing to purchase may result in the risk of facing the following **PROBLEMS**:

- fast evaporability;
- poor heat transfer;
- low boiling point;
- flammability;
- splashes on clothing and equipment;
- oxidation when interacting with oxygen;
- thickening;
- unpleasant smell;
- loss of dielectric properties while operating in 24/7 mode.

OUR INVENTION was specially designed for miners with any technical equipment and considers all the mentioned nuances. Below you will find the results and achievements of our research.

IMMERSION LIQUID DESCRIPTION

COOLANT

For mining equipment cooling we offer a specially developed content with unique characteristics — **COOLANT**, dielectric non-polymerizable immersion liquid. It is designed for equipment of both industrial scale and small farms.

COOLANT IS TESTED ON VIDEO CARDS (GPU) AND ASICs OF ALL BASIC TYPES.





Our immersion liquid is odorless, non-toxic, not fluorescent, presents no danger for people and animals. Can be cleaned with warm water and soap.



Both new and used equipment can be immersed into Coolant. Pre-owned equipment requires minimal action from the owner - dedusting and dismantling the air cooling system. This will be enough for preparations before immersing.



Coolant doesn't contain water and paraffin, selective solvents and mechanical impurities. It is compatible with insulation materials, electronic components and is ideal for immersion cooling. All couplings retain their original condition and are not oxidized by the liquid.

To confirm the properties of the immersion liquid, **COOLANT** studies were carried out, which led to the following **RESULTS**:

1 During tests in open and closed crucibles, the immersion liquid demonstrated a high level of fire safety. The operating equipment showed incapability of causing a fire. No special measures required when handling the liquid.

2 The capability of the content to maintain the original properties in operating equipment is called the stability of the immersion liquid. In the process of long-term operation, Coolant haven't changed its original color and demonstrated dielectric strength. The level of breakdown voltage remained at the acceptable level and haven't oxidized when interacting with oxygen.

3 Pour point is not higher than -20° . However, as the pressure increases, the pour point also increases, which allows the immersion liquid to operate in cold climates. COOLANT isn't afraid of sudden changes in temperature.

During 1 year of operating, the non-hygroscopic composition of liquid was confirmed. Which proves its inability of interaction with water and absorption.

4

5 In the environment there are substances that accumulate in the composition as sediment or in an undissolved state — fibers, dust, dissolution products of paints, varnishes, metals from the transformer construction, coal and slag. In our case the figures don't exceed the permissible values and don't affect the performance of equipment.



IT IS POSSIBLE TO KEEP THE IMMERSION LIQUID IN PLASTIC CAPACITIES, IT DOES NOT VAPORIZE WHILE STORING OR DURING THE WORK PROCESS.

Immersion liquid **COOLANT** is an eco-friendly product and doesn't harm the environment. Measures for its disposal are not far more complicated than for vegetable oil. It can be used by both beginners and experienced miners, who have decided on an innovative system of immersion cooling.



ECO

ON THE WAY TO INNOVATIONS

Immersion cooling gradually replaces the traditional “air” cooling. Its benefits will be fully revealed in combination with computing equipment that can't operate using outdated heat removal technologies. So the first towards the new solutions is mining equipment.



Immersion cooling will allow to “restart” the mining process, make it more profitable, environmentally friendly and attractive for investments. Immersion liquid plays the central role in immersion cooling. The development of **COOLANT** combines all the properties necessary for its usage as a coolant for immersion cooling.



IN THE BASIS OF COOLANT lies the formula developed by professionals who considered all the preferences of miners. It allowed to create the most effective and safe product. As a part of the study it performed high quality and the ability to solve the most complex problems.

**TRUST PROFESSIONALS AND GET A SIGNIFICANT COMPETITIVE ADVANTAGE
IN COMPARISON WITH OTHER PARTICIPANTS OF BLOCKCHAIN PROJECTS.**