



POWERCHAIN

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## A Peer-to-Peer Virtual Power Plant

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# Abstract

Powerchain — a project that will respond to the energy revolution taking place before our eyes. Generation 2.0 (P2P VPP V. 2.0) is a decentralised virtual power plant, built on the participant's equipment, which consists of nodes that define the interaction mechanisms between each other without traditional power grid weaknesses.

DVPP (Decentralised Virtual Power Plant) is a platform created to optimize current types of energy lines operations. This Powerchain platform fulfils three main functions:

- power buffering;
- energy utilization;
- clearing

Platform nodes are formed by installing and connecting a smart controller to its grid. The smart controller is the Powerchain project own development, tools for accounting and data exchange with the Platform, with the opportunity to manage the generated nodes.

The smart controller is able to predict node equipment problems, define the weaknesses of the network within predictive analysis, and help to optimize the nodes power consumption.

The Powerchain project creates a wide range of interaction within nodes. We use the concept of "Prosumer" (consumer + producer = prosumer) — user (node), which can act as a producer, buyer and optimizer of the created smart network at the same time.

**Buffering.** Drive node is created based on a smart controller connected to the Powerchain platform for energy accumulation and storage equipment. It can be rented to other members, applied for personal needs and provide power to additional users (nodes) as well. Based on the terms, the platform automatically selects the nodes, settles among them a smart contract and enforces it. The drive node gets a payment.



**Utilization.** Node-users connected within smart controllers to the Powerchain platform will be able to use electricity from each network member. There are plans to connect to the reserve energy station platform that it's not utilising its capacity to generate, in the case of a blackout (accident). So, the mentioned generators will be able to get a reward from other platform nodes without any unavailability risk during blackouts in central network sessions.

As the first before-mentioned users, we intend to use cryptocurrency mining containers produced by one of our associate partners. Miners will get access to the platform's own resources and additional nodes, while backup generators will be able to get additional reward. The platform is responsible for arranging contracts between members while creating and fulfilling smart contracts on the blockchain.

**The Clearing.** The legal method of clearing (payment processing) is accomplished. It will provide transparent and legal conversion the platform nodes reward into fiat money, create opportunities for cross-border actions and reduce geographic barriers for members.

Due to outstanding balance, the Powerchain platform resolves the problem of integration of renewable energy, which will become the main energy source on the planet in the following decade.

The use of storage nodes and user nodes creates a powerful and useful tool for balancing the whole power grid. Reduces peak shaving in the network, improves the nodes efficiency, reduces the costs of reserve generations building and maintaining, reduces the electricity expenses.

We create a community where each member can get the a required amount of electricity at any time at attractive price. We destroy inequality in the access to electricity. No one should accept imposed rules anymore.

The platform will be built on Ethereum blockchain using smart contracts. POWEC token will be used to conduct all transactions between the participants nodes. In turn, blockchain helps to surely secure all operations. Smart contracts guarantees the performance of obligations better than any legal agreements, and the token acts as a general means of calculation.

The protection system is secure by Platform design, while the monitoring and predictive analysis system allow to predict problems in advance and avoid emergency incidents.



At the business process level, an additional “immunity” setting was created, with a self-training program for monitoring and analytics of platform members actions, which allows to avoid a possible harm from unfair users.

At the program level, the platform is protected by artificial intelligence that can block cyber attacks without human intervention. Based on traffic analysis and platform vulnerabilities, the program automatically determines the best way to respond to each invasion.

In accordance with agreements reached, members of our community can be offered a privileged partnership in the development of robust storage nodes on the basis of innovative kinetic energy storage system (KESS) and hydrogen storage system (HSS). Additionally, we assist in problem-solving of purposeless resources creation by joining mining farms and before-mentioned types of storages to produce further income.

The combination of all these choices into the unified ecosystem of Powerchain was achieved by involving in the plan the partners from leading technological companies, coordinated work of founders and the team of experts, who know and love the business.



# 1. Intro (Manifesto)

Power engineering — one of the most important parts of life support. More electricity is required to satisfy the ever-growing needs of the world economy, raising the demand for innovative resolutions in the industry. Technology growth means creating new principles of relations between people.

Logistical energy “curse” is the failure to deliver the demanded quantity of power to the consumer, without building a vertical hierarchy and managing the delivery system by generating and monitoring bodies. Till recently, there was a serious technological reason for that — inability to store energy for a long time and produce it there as much as it’s needed and then when it’s necessary to use.

To create the decentralized Energy Community (**decentralized EMC**) based on digital economy, Powerchain project utilises allocated register (**Distributed Ledger**) technologies.

Energy Management System (EMS) systems have been built to optimize generation, distribution and consumption operations. Those systems were designed by leading companies in the manufacturing of electrical power devices such as General Electric, Hitachi, CEBYC, Control Data Corporation, Siemens and Toshiba. Thanks to their work, enormous numbers of data about the power flow and statistic were collected.

However the vertical hierarchy limits opportunities for power systems development, as by its nature isn’t able to carry out the complete balance of the system.

The relevance of the decentralized energy flow control system increases. In past years, an alternative power generation, renewable energy sources and new ways of storing electricity have been actively developing. All that creates radical changes in a traditional power grid structure.



With the rise of decentralized generation, slowly, but certainly changes the roles of the power system participants. The borders between traditional consumer and producer are blurred, creating a new member type — prosumer, which simultaneously consumes and produces electricity. The simplest prosumers are the households keepers that installed solar and wind power plants.

Households can swap generated energy, buy and sell it to each other, together determine the conditions of their cooperation. Such trends as the growth of renewable energy sources (RES), decentralized generation and the evolution of prosumers totally change the energy market situation.

Based on unique professional experience and breakthrough inventions, the Powerchain team has developed a strategy of modular architecture and scaling of decentralized energy communities, which can be utilised at a city, region, country and inter-territorial energy system level.

Main purpose of the platform — electrical networks balancing by buffering via storage devices, utilization through cryptocurrency mining and clearing.

The initial step in implementing the project will be the creation of the Powerchain Management platform — a decentralized platform for electricity operations based on blockchain technology.

Our platform includes progressive IT solutions: prediction of technical problems, business processes and an advanced cybersecurity system. That allows to reach the highest level of reliability and balance of power grid, and to manage resources with maximum efficiency for all members.

One of the most important functions of the Powerchain platform — organizing energy storage on various types of the grid storage systems. Members of Powerchain are rewarded for their electric power administration and optimization work according to the economic model of “co-consumption”

Thanks to blockchain technology, the project uses a new for the energy industry kind of money, produced on the blockchain-network Ethereum for electricity payments — a Powerchain Token (POWEC). The value of this token has a valid base, as it depends on the whole energy potential of the platform members.



We are going to build a Powerchain community based on innovative approaches and technologies. All communications between the ecosystem members will be fixed in smart contracts, which ensure their rights safer than any legal agreements.

First of all, the Powerchain platform is focused on building a fair and jointly profitable scheme of cooperation between members based on their interests.

**We don't invent electricity, we return it to people.**





## 2. Market analysis

The world's electricity industry is on the verge of revolution that will significantly decrease costs and harm to the environment in the production and transportation of electricity.

Welfare gains and technological progress are steadily increasing the demand for energy. At the same time, the society truly demands to generate electricity from the less harmful sources, and also use it more efficiently.

At the heart of this revolution — the usage of environmentally friendly and renewable energy sources, creating smart energy systems based on information technologies, improving the network efficiency and consumers self-sustainment.

### 2.1. Renewable energy

First of all, the energy mix is changing.

The electricity industry of the past operated on fossil fuels. With the ongoing development of the world economy, the electricity consumption inevitably grows. This involves an increased level of toxic emissions in the atmosphere, first of all, carbon dioxide, which in turn harms the ecosystem.

To reverse this trend, different countries are working on more environmentally friendly electricity production.

One of the key measures to reduce carbon dioxide emissions is to use the renewable energy sources (RES). In addition to the lack of toxic waste in the process, they use unlimited natural resources that exist in any country.



The main sources of green energy:

- Water — hydro-power plants;
- Sun — solar power plants;
- Wind — wind power plants;
- Earth subsoil — geothermal power plants.

Solar and wind generation are the primarily fast-growing industries. Solar and wind generators owners are usually small businesses and private individuals. A large number of small companies creates conditions for decentralization of electrical supplies and increase the competition between suppliers at the local and regional levels.

Green energy is rapidly developing and now, according to the International Energy Agency (IEA) report, covers production of 24% heat in the world, and 18% of electricity<sup>1</sup>. From 2017 to 2040, two-thirds of total investments in new capacities will be made in renewable sources, first of all in wind and solar power plants. Thereby, by 2040 RES will control up to 40% of overall world production capacity. An increased popularity in recent years is due to the green energy cost reduction, primarily through the technological development and Government restrictions on the use of traditional sources<sup>2</sup>.

According to Bloomberg New Energy Outlook 2018, development of technologies will lead to dropping cost of solar and wind energy production, which will further contribute to the development of electricity storage and accumulation technologies. According to analysts' forecast, by 2050, thanks to those reforms, more than a half of total power in the world will be produced within wind and sun<sup>3</sup>.

For the use of RES, there is also an economic reason: many countries remain fossil fuels importers, which makes them dependent on a small number of suppliers, and each cycle of fuel price increase has a negative impact on the economy.

European Union is one of the centres of the green energy revolution.

The accelerated move towards the RES use was approved in June 2018 by the European Commission, which determined to increase the green

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<sup>1</sup> <http://www.iea.org/weo2017/>

<sup>2</sup> <https://www.ft.com/content/9e0119a4-4fa5-11e8-ac41-759eee1efb74>

<sup>3</sup> <https://about.bnef.com/new-energy-outlook/>



energy strategy targets by 2030<sup>4</sup>. According to the latest plan, the percentage of renewable sources in the European energy structure will increase from 27% to 32%. Moreover, by 2030, the EU economy should decrease carbon emissions by 40%.

Other sources of energy, on the contrast, disappear. Thus in Europe, consistently abolish to use coal-fired power plants<sup>5</sup>. In 2017, renewable sources in the EU are now equal to the total volume of electricity generated from coal, which production volume has been decreasing since 2012. Finally, eliminate coal from the power system is expected by 2030.

According to the IEA, now about 80% of all new capacities in Europe are using RES, and after 2030 they will become the main source of electricity in the region.

Not only European developed countries support green energy. In order to obtain economic advantages and enhance energy independence, RES is being actively implemented in developing countries.

According to the IEA calculations, the increase in electricity demand by 2040 will come mostly from emerging regions, two-thirds of which will supply Asia and the rest — Africa, South America and the Middle East.

India, one of the leaders of the green energy revolution in emerging countries, plans to reach the total solar and wind power capacity to 160 GW by 2022<sup>6</sup>. In partnership with India, Nigeria has too assumed a programme to reach 30% target of RES in the structure of the national energy system by 2030<sup>7</sup>. However, according to the UN report, renewable energy will be a key solution to electrification of the poorest countries, 600 million inhabitants of which do not have access to electricity<sup>8</sup>.

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<sup>4</sup> [http://europa.eu/rapid/press-release\\_STATEMENT-18-4155\\_en.htm](http://europa.eu/rapid/press-release_STATEMENT-18-4155_en.htm)

<sup>5</sup> <https://www.forbes.com/sites/energyinnovation/2018/06/11/uneconomic-coal-could-be-squeezed-out-of-european-union-power-markets-by-2030/#5e9854b34179>

<sup>6</sup> <https://www.livemint.com/Industry/jufptIWCH73mwj5ibSw2OI/Climate-change-to-affect-Indias-renewable-energy-plan-Stud.html>

<sup>7</sup> <https://www.dailytrust.com.ng/nigeria-targets-30-renewable-energy-by-2030-partners-india-257508.html>

<sup>8</sup> <http://unctad.org/en/pages/newsdetails.aspx?OriginalVersionID=1608>



China continues to lead the green economics implementation. According to the UN Environment Program report, in 2017 more than \$200 billion worldwide was funded in this industry<sup>9</sup>. China's share was more than \$126 billion, 30% more than in the past year.

An essential driver of electricity demand growth is the increased interest in electric and hybrid vehicles. If now those types of transport represent slightly more than 0.2% of the entire world electricity, by 2050 this indicator will reach 9%<sup>10</sup>. In developed countries like Germany, electric transport will consume up to 25% of total electricity.

According the IEA forecasts, there will be from 2 to 9 million electricity-powered cars in the world by 2020 and between 40 and 70 million by 2025<sup>11</sup>.

The development of electricity-powered transport drives forward the battery industry and infrastructure of electro-gas stations.

## 2.2. Energy accumulation and storage

All of the above factors provoke consumers distrust of old power grids management methods applied by power supply companies. The improvement of energy storage technologies has led to new solutions that allow energy to be accumulated and consumed only in the required volumes and only when it's necessary.

The drop of renewable energy costs and the connection to accumulation systems create a situation when wind and solar energy can become the basis of utilities. The power grid is facing peak loads that differ by region and depend on the time of day and season.

During peak loads, utility services connect backup generators unloading the network. Though, the launch of those stations requires a lot of money. Receiving power from the accumulators is significantly cheaper and more comfortable.

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<sup>9</sup> <http://www.businessinsider.com/solar-growth-outpaces-coal-oil-fossil-fuels-2018-4>

<sup>10</sup> <https://www.bloomberg.com/news/articles/2018-06-19/electric-cars-are-going-to-suck-up-9-of-world-s-power-demand>

<sup>11</sup> <https://www.iea.org/newsroom/news/2017/june/electric-vehicles-have-another-record-year-reaching-2-million-cars-in-2016.html>



For this reason, in past years the market for electrical energy accumulators developed significantly, and like renewable power became a new trend.

According to the Morgan Stanley forecast, released in 2017, the U. S. electricity storage market will rise from less than \$300 million to \$4 billion by 2020<sup>12</sup>. According to the bank's analysts calculations, the global market will soon need the capacity of up to 85 GW per hour of energy storages costing \$30 billion a year.

According to the Bloomberg New Energy Finance project, the popularity of electricity storage systems will increase steadily, as well as solar power last 15 years<sup>13</sup>. By 2030, the whole world capacity of accumulating plants will reach 300 GW H. 70% of this volume would be settled in the USA, China, Japan, India, Germany, Great Britain, Germany, Australia and South Korea. Investments in the industry between 2016 and 2030 will be more than \$100 billion.

2017 was marked in the U. S. as a boom year for sales of energy storages for households<sup>14</sup>. According to a survey carried out by the American Association of Energy Services professionals at the end of 2017, almost a third of consumers in the United States already own energy storage and distribution systems<sup>15</sup>.

Meantime, China employ various ambitious solutions. According to the Beijing Development plan, one of the new city districts will build large-scale energy storage stations for 16 large industrial plants<sup>16</sup>. The stations will be placed under the buildings. At night they will be charged and in the daytime will supply energy to businesses. According to official statements, the storages maintenance will help to secure the power system performance, blocking potential blackouts, insufficient power problems and network failures. The storage equipment allows to decrease the load on the power plant by 2 billion kWh per year. Simultaneously, the development of wind and solar generation is considered in the same district.

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<sup>12</sup> <https://cleantechnica.com/2017/08/16/morgan-stanley-predicts-market-grid-storage-will-explode-next-3-years/>

<sup>13</sup> <https://about.bnef.com/blog/global-storage-market-double-six-times-2030>

<sup>14</sup> <https://www.digitaltrends.com/cool-tech/solar-powered-batteries-could-be-the-future-of-your-home>

<sup>15</sup> <https://www.solarpowerworldonline.com/2017/11/almost-third-consumers-reported-form-distributed-energy-resources>

<sup>16</sup> <http://en.silkroad.news.cn/2018/0625/100687.shtml>



In general, electrical storages — an excellent opportunity to stabilize the electricity generation from renewable sources that are not always able to meet the demand because of the vagaries of weather and climate. According to the forecasts of Bloomberg New Energy Outlook report, the development of accumulation and storage technologies will allow renewable energy to control more than half of the world's electricity generation market.

## 2.3. Traditional grid problems

Today, as 100 years ago, electricity is mostly produced at large plants and distributed to a wide variety of consumers, from large businesses to small households. Often there are also power grid operators between the manufacturer and the consumer.

Such an over-centralized structure has several significant disadvantages:

- 1. High prices for consumers.** Consumers are forced to pay fixed tariffs, which includes a profit of the manufacturer and all kinds of intermediaries, as well as costs of management and large corporations depreciation, which effectiveness is doubtful.
- 2. No rights to vote.** The consumer cannot influence the structure of the grid and is forced to rely entirely on the corporations owning the production capacity and infrastructure.
- 3. Lack of competition.** Each power grid is local and not always efficient. The consumer cannot choose the producer and supplier and forced to put up with it.
- 4. Vulnerability to external threats.** Lots of people suffer from local violations because of the centralized structure. The famous blackout in 1977, which left the large part of New York without electricity and lasted more than 24 hours, was caused by lightning in the local power substation and the power line. Slow upgrades of hardware and software make it difficult to implement modern security solutions against cyber attacks.
- 5. Inefficient structure.** Energy is regularly produced quite ineffectively, from old sources. Poor management of the grid leads to the fact that electricity is supplied at long distances with a high level of power loss.



#### 6. **Forecasting errors leads to increasing electricity cost.**

Traditional generation works on the principle of its users consumption prediction. But if the amount of electricity consumed is lower than the estimate, the consumer is forced to pay a fine. If consumption exceeds projected, then the consumer is forced to buy the missing volume at higher tariffs.

#### 7. **Rejection of prosumers.** Despite the appearance of many technological solutions that allow consumers to start producing energy, traditional systems deny to accept them. Small producers are hard to connect to the grid, they face unnecessary bureaucracy and low profitability.

## 2.4. Powerchain solutions

Powerchain platform, aimed to stimulate energy buffering technology, can effectively solve the problems of traditional power systems:

1. **Reduced electricity prices** The stability of the Powerchain “virtual power system” is based on the mass storage batteries utilisation, and allows to balance the network. That mean to supply merely as much electricity as it needs at the moment, without generating excessive loads on the network or loss occurrence. The virtual platform allows you to determine the most appropriate provider for such parameters as the distance to the consumer, the capacity for delivery and the source type.
2. **Decentralized control scheme.** A significant part of the platform’s functions operate in automatic mode thanks to the advanced IT solutions. The platform’s efforts are focused at ensuring effective interaction between its members.
3. **Fair competition between suppliers.** The platform operating principle is based on free communication among members. Request for electricity is met by open competition. On our platform, any supplier competes for the consumer, whether large CHP or small household. Always wins the one who can offer the best terms.



4. **High level of protection.** The decentralized platform structure means that in the case of an unspecified problem only a modest part of members will suffer, the rest won't know about the problem. However an accident is unlikely to occur as we use artificial intelligence technology and computer learning not only to guarantee the highest level of security but also to prevent any failures.
5. **Effective suppliers.** The work of our platform is aimed at satisfying consumers needs. The benefit in such system applies to the suppliers who can offer the best tariffs. The decentralized structure allows to solve logistic problems without enforcing a specific manufacturer.
6. **Balanced system.** One of the main features of our platform is the real balance of the system. The balance is performed by energy buffering based on the necessary planning limit. The platform allows you to determine which accumulators are guaranteed to be available on a particular day and hour. We utilize the energy, what the platform cannot save, by assigning electricity kilowatts to cryptocurrency over mining containers.
7. **A proper place for alternative energy.** Thanks to energy buffering, green energy sources can accumulate almost any amount of electricity and supply it according to current demand, not just only during production.
8. **Prosumers — main participants of our platform.** Due to the fact that the central role in our platform is assigned to the energy buffering functions, every consumer can become a manufacturer. We don't impose any restrictions to connect new producers of any sources, whether it's a tiny "windmill" in the yard of your house or Cascade HPP.





# 3. Platform description

**Powerchain Platform** — a blockchain platform that allows its members to store electricity and use it when needed and transfer excesses to other users or utilize it. A number of extra functions and clearing mechanism are also implemented in the platform.

**The principle of 3D** — use of Distributed Data Register Technology (**Distributed Ledger**) to create decentralized Energy Community (**Decentralized Energy Management Community**) based on the Digital Economy (**Digital Economy**).

The use of Ethereum blockchain and the inclusion of additional technological solutions of its own development allow to create a steady and effective system — a virtual power grid without traditional networks shortcomings.

The platform enables to build a large distributed energy storages with drives registered in system, receive an energy and use it.

Each storage node is able to function separately and self-sufficient, but all of them together create a powerful and at the same time extremely flexible energy structure.

The structure can be used to:

- steady and balance network;
- reducing the cost of electricity for consumers in the peak zone;
- reducing network balancing expenses
- easy and fast integration of new power market participants into the network;
- cross-border electricity transfer and trade;
- reduction of a single temporary trading block through electricity trade.



The smart controller and the accumulator can be enrolled by any member of the system, from a small household to a huge energy producer, such as a nuclear power plant or HPP. All calculations are made inside the system using an exchangeable POWEC token.

Undoubtedly, the key platform players will be network companies that transport electricity from producers or generators to the consumers. At the same time, we mean effective cooperation between two mutually supportive and interdependent systems: infrastructure (transportation of energy at the physical level) and logistics (optimization of shipping). The presumed effect of this cooperation is loss reduction and overall efficiency increase.

Some projects in the digital economy disregard the need to structure relations with infrastructure systems, which in our opinion is unacceptable. For example, only a few months after the start of business, Moscow car-sharing companies came to the idea of the necessity to lobby for SDA amendments, which would assimilate car-sharing cars to public transport and allow to move on specially marked transport lines.

An excellent example of effective communication with network companies can be the Powerchain ECO project, which will create a transfer of so-called "green Kilowatts", generated from landfill gas on one of the Moscow area garbage landfills, to environmentally oriented businesses that have provided a quota for these environmental kilowatts in their consumption.

### 3.1. Platform Work Scheme

To become a platform member, a single user or organization must connect the Smart Controller to own network and sign up on the Powerchain platform. Smart Controller becomes main link to the platform, channel for two-way flow of information and power management.

In order to begin supplying electricity to the Powerchain network, in addition to the smart controller the member need also to connect and register the storage. Energy storage is the principal power balancing tool on the Powerchain platform. The smart controller is a device for managing accumulation systems too.

The platform autonomously distributes energy among users taking into account the parameters of requests placed by potential consumers.



### 3.1.1. Energy utilization

The main difference and benefit of the Powerchain platform is the possibility to implement the effective multi-stage electric power transformation based on a unique selection of patented technologies.

Due to the peak loads in traditional power grid, producer and operators include reserve generators. They are forced to stay in “hot” mode, and their service is a waste of money.

If for any reason, the energy storage with consequent utilization is not available or can't completely compensate/balance the existing electricity surplus at the time, it may be distributed. The platform lets consumers trade surpluses of accumulated electricity. As a pilot solution for the energy utilization on the Powerchain platform, a unique program will be implemented to send energy to the mining nodes, varying from the household mini-node to the mining farm.

In order to connect to the platform, the miner needs to set the smart controller and register on the platform. After that, he can choose the conditions on which he demand electricity and starts working.



*Powerchain platform in use*



### 3.1.2. Accounting on the platform

All calculations, transactions and payments between the platform members are carried out in POWEC tokens on Ethereum blockchain. The platform pays off the equipment owners for their services with POWEC tokens.

The reward amount for the "STORAGE" service depends on:

- type of storage;
- capacity used;
- electricity storage time.

The platform provides consolidation of the member's storage battery capacity and regulates the wholesale of the service, which allows to use each particular node in the most productive way and receive the maximum possible reward during its operation.

In addition, network members pay the admission fee when sign up online. The contribution goes to the smart controllers production. The contribution is 50 ' 000 POWEC tokens.

To cooperate with big companies that are not yet able to carry out transactions with tokens (put them on balance, write off, etc.), it's planned to use a separate entity, which will act as a clearing company. For big international corporations, the company will become a "window into the world of blockchain" and will handle clearing on the platform

## 3.2. Platforms additional features

### Energy Accounting

Any member of the platform, when connected to the smart controller, will be able to get the support for monitoring power consumption and optimization of energy consumption.

### Power transmission

Each user will be able to transfer electricity between accumulators and consumers within the network, as well as to external members.



## Electricity trading

With the development of the platform, the function of cross-border electricity trade will be implemented as well as the ability to make payments for electricity and relevant services.

## Special solutions for mining

With the assistance of Powerchain, we offer to use reserve capacities for mining by connecting with mining containers.

## 3.3. Platform members

The following are the types of Powerchain platform members and the steps that are required to start their work:

### Storage

- buy storage equipment;
- buy tokens  
(go through the procedure KYC — “Know your Customer”);
- get a smart controller;
- apply for insertion in the network.

### Consumer — miner

- buy mining equipment  
(ASIC — “application-specific integrated circuit”);
- buy tokens (pass KYC);
- get a smart controller.

### Generator

- buy tokens (pass KYC);
- get a smart controller;
- apply for energy supply to the network.

### Broker

- buy tokens (pass KYC);
- get a smart controller.



### Attractor

- buy tokens (pass KYC);
- get a smart controller;
- connect other users to the platform.

Once you have access to the platform, all nodes (members) can communicate with each other. Any member can change his or her role as desired. Members can unite among themselves in groups, creating super-nodes and becoming producing, accumulating and transferring electric energy. full-fledged prosumers.

In the Powerchain, the electricity storage becomes a “virtual power station”. Thus, for energy supply to the user, it’s not necessary to have the source of its generation.

Tokens that will be paid for the connection to the platform will be used to attract other members. The project will have a referral program, whereby by bringing other users, everyone will be able to receive the token as a reward.

## 3.4. Project advantages

### 3.4.1. Security

The distributed system means enhanced security measures. We use several levels of Powerchain platform protection. Security at the business process level aimed to identify the logical vulnerabilities that cause the greatest harm because they can be utilised by system users. We create an analytic layer that performs the role of resistance, unveils deviations in typical platform actions or interactions between members.

This approach allows to catch the attempts to use possible vulnerabilities at the time of action that violates system logic at the business process level. The important part is that our system, unlike many similar solutions, works without the constant creation of fraudulent actions examples. It’s a self-training protection mechanism without “delay from attacking” problem.

Our team has employees who have been working on protection systems for data systems and applications for more than 20 years. The modules



of our system are designed and developed in full compliance with the SDLC (Security Development LifeCycle) requirements and are tested at each stage of the life cycle (architecture, coding, functional testing, Beta testing). After each update, the software runs an automated full-featured pen-test, and the vulnerabilities found are closed by real and virtual security patches. This technology allows to reduce to almost zero false activation and effectively block attacks by hackers, users and even administrators.

### **3.4.2. Modern technology**

One of our key developments is smart controller. It's a universal processor that connects the power equipment of a system members in a single data network. Protected from firmware opening and modification, it provides two-way communication of the devices with the reliable data core, passing encrypted information by any accessible communication channels. The identification of nodes is made by a unique algorithm.

The system of equipment nodes monitoring and analytics connected in the Powerchain platform allows to have reliable data about their current status and to predict the status of connected devices at the moment defined by smart contracts.

Solutions to manage and optimize the consumption, accumulation and electricity purchase at different time periods allow you to control the efficiency of electricity consumption.

The use of matrix architecture solutions with cross technologies gives a huge synergy effect.

### **3.4.3. Community**

We create a free self-regulating energy community, in which the members play an active role. Users can vote and influence the decision making on the project development.

### **3.4.4. Reliable mean of calculation**

Use of your own POWEC token allows to create a self-sufficient financial ecosystem that is supported and improved by the member's activity. Token secured by electricity and the member's storage systems.



### 3.4.5. Ready-made solutions

The solutions provided for the Powerchain implementation are already used for the system solutions development for large corporate customers in different countries, in particular, the companies “Russian Railways” and “St. Petersburg Underground”. This gives a fantastic daily experience of actual work, guaranteeing constant growth and improvement.

The modular structure gives Powerchain a chance to superfast system development. A list of now ready-to-market or already tested modules:

- Universal Smart Controller;
- Cybersecurity modules;
- Business process security modules;
- Universal platform for data collection and verification;
- The corporate centre of reliable data;
- An industrial platform of mutual settlements;
- Digital wallet system;
- Energy storage system and electricity conversion in cryptocurrency, etc.

### 3.4.6. Unique developments

Lots of system elements are the result of our intensive long-term scientific and technical research. They are available exclusively to Powerchain platform members.

Therefore, our partners from the company “Kinetics” have developed the first practise model of a burst-safe super flywheel, which requires a registration of more than 30 patents and author’s certificates. They have created a secure super-flywheel with a huge life source on charge and discharge flows. It’s a kinetic energy storage devices that can accumulate electricity up to 70 kWh. On its base, it is possible to create storage nodes with a capacity of several megawatts. The recovery system based on such nodes in the National rail transport system is capable of providing energy savings at a tens of percent level.

Another example of innovation is the hydrogen (electrochemical) storage system. This system allows solar generation plants to carry out round-the-clock electricity supply to consumers.

Implementation of these developments became possible only in decentralized Powerchain Energy Community system.





### 3.4.7. Borderless

Powerchain erases the borders between households, energy companies and national power systems in the energy storage area. It helps to control energy balancing and connected calculations.

We are able to balance and modify micro-networks into global system that can operate at any scale, crossing state borders.

### 3.4.8. Special solutions for miners

We have developed and provided for the production a new generation of mining containers, with a capacity of 1.3 MW each. They are created based on The Bitfury ASIC and, in addition to the high computing power (hash rate  $\geq 7.5$  PH/s Bitcoin) have the additional option of instant capacity flip-over.

## 3.5. Platform architecture

### 3.5.1. The network administrator

Powerchain Management platform act as the system administrator, determines the roles of the members, provide a smart contract “admin — member” or “member — member”. The system also performs the role of a broker on the energy exchange. Powerchain management platform guarantees the implementation of payments on the energy exchange or transactions between the platform members.

#### Admin functions:

- check members possibility to generate or consume energy, payment capacity and physical presence in the selected area;
- connection to the network;
- system protection from external negative impact, technical or software;
- adjust predictive analytics settings to identify the behaviour patterns of members and further monetization of these data;



- increase in the number of participants;
- monitoring and analysis of all types of nodes connected to the platform;  
This will enable to have adequate data about their condition and make a forecast for the moments determined by smart contracts.
- business processes monitoring and predictive analytics;  
This maintains an effective platform management system, and also protect from fraudulent activities;
- clearing.

### 3.5.2. Blockchain and smart contracts

The base of any communication among platform members is a multifunctional and multilateral smart contract based on the Ethereum network. Platform operations that use Ethereum smart contracts:

- token smart contract;
- token sale smart contract;
- smart contracts that connect request for energy storage with requests for acquisition;
- smart contract which is functionally connected to smart controller, based on the network signals, performing specific operations.

The implementation of smart contracts provides the following functions and parameters:

- **Registration.** This procedure transmits the following parameters to the network: storage system type, capacity, rated voltage (based on storage system type), minimum and maximum storage time.
- **Platform's verification.** Request from the platform to the controller about the storage system status and compliance with the listed parameters. In case of successful verification, the energy storage becomes ready to use. Controller can adjust the stated parameters to the real ones, and continually checks the storage presence in the grid.



- **Applying.** The procedure uses the same data, it's also possible to configure the utilised capacity, but not more than fixed one, and the requested rate, which will be regulated by the predictive analysis system.
- **Accumulation applying.** This function uses parameters such as the origin, location, the volume of power for storage, storage duration, storage and supply period, tariffs.

For example, in order to unload electricity, store it for a specific period of time and return to the network, the following parameters are determined:

- The requirement of the generating node to unload the total amount of electricity and the requested time of its storage;
- The possibility of a single storage system on the acquisition of this electric power share;
- The technical state of the storage node and the prediction of guaranteed storage during the required period of time within the permitted wastes;
- Competence of the requested reward for storage of the generating node or the nodes agreement with the current tariffs for these services;
- Alternative availability for storage from other nodes;
- Options available for the electricity distribution with conversion it to cryptocurrency or tokens and following power acquisition for cryptocurrency or tokens.



# 4. Technical description

## 4.1. Green Ball, the smart controller

To cooperate with users, the Powerchain platform uses the smart controller Green Ball. It's a special processor that connects to the power grid and exercises equipment management and data collection from sensors, as well as gives a visualization of current parameters.

The smart controller is connected to the user's power grid by a switch-board. It's able to identify different equipment that consume electricity. This smart controller includes complex accumulation algorithms, initial analysis, data management and security, consolidating different equipment and sensors into a single network.

The main purpose of the smart controller is to manage the storages and carry out the transfer of power from the storages to the Powerchain network and back. The smart controller is responsible for connecting the user and all of its hardware to the Powerchain platform. It manages user-side data, assists to transfer data among users and the platform, and performs user tasks.

However its abilities are not limited to the platform functionality. It's able to analyze the operation of any users network equipment and identify problems with the equipment, such as increased energy consumption due to a malfunction or ineffective use. If there is a problem with the hardware, the smart controller report it to the user using its corpus display.



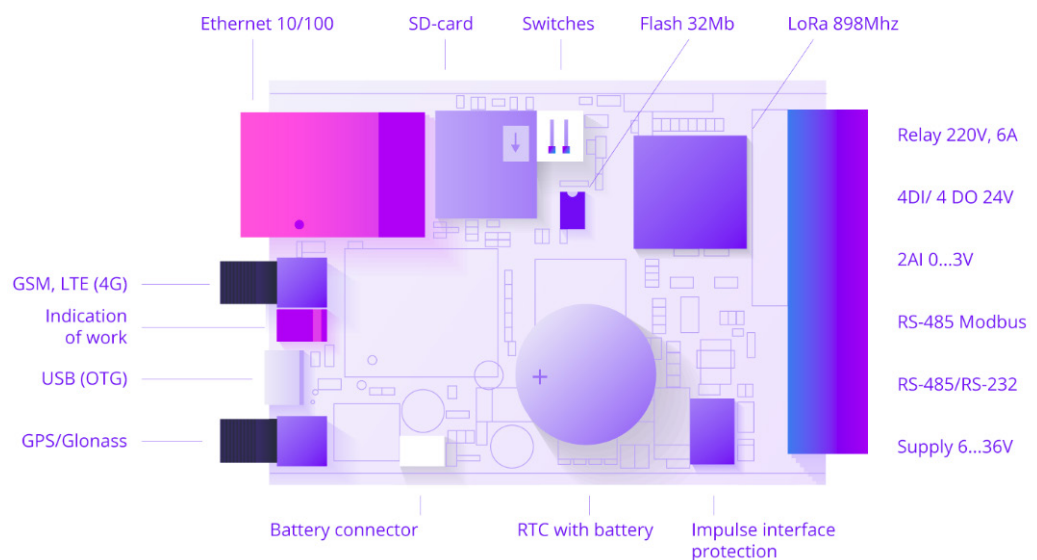
The smart controller enables you to not only connect and use all Powerchain platform opportunities but also immediately troubleshoot problems in your network, which will allow its owner to save on their own power consumption, regardless of the use of ou.

### Smart controller technical specifications

- 32-bit ARM-processor with a 100 MHz frequency;
- Flash-memory 32 MB;
- Four input and output with galvanic isolation to connect to discrete and impulse sensors and devices;
- Normally open relay for signal control up to 260 VAC, 2 A;
- Two analogue inputs 0...3 in;
- RS-232/RS-485 interface for connecting the electric meter or any other commercial accounting device (MODBUS protocol);
- RS-485 interface for connecting external I/O modules or other devices;
- Slot for connecting the SD card;
- Lithium-Polymer battery 3.7 V, 1000mah for autonomous operation, with scheme of power and charge control or lithium battery 3.6 V, 19 000 mah;
- volatile real-time clock RTC for storing measured parameters with astronomical time-bound;
- GSM-Module for information transfer to the server and coordinates determination;
- GPS/GLONASS module for geographical coordinates determination and binding to exact time signals;
- Wideband transmitter with LoRa modulation, frequency 868 MHz, power 25 MW, communication range up to 3.5 km in urban development and up to 15 km in line-of-sight;



- Bluetooth/Wi-Fi module to transfer information to the data collection server;
- Ethernet Port 10/100;
- USB OTG Port;
- Control system of unauthorized access and corpus opening;
- LED status indication;
- switches of operation modes;
- Software-hardware protection of transmitted and stored information, protection from corpus opening;
- Input power 6...36 VDC;
- Overall dimensions 85×61×22 mm;
- Operating temperature range: from -40 to +55 °C.



*Smart controller*



### 4.1.1. The use of smart controllers

#### 1. Electricity accounting, generation, storing, distribution

The smart controller measures and archives instant values of active and reactive power, current, voltage, frequency and power indicator in the network. Depending on the tasks, this equipment controls power generation and electricity storage equipment, performs diagnostics and analysis of the equipment status.

#### 2. Public resources consumption accounting

The smart controller uses accounting devices and sensors to account for consumed energy sources like water, gas, etc. The controller reads, analyses, guards and transmits information.

#### 3. Mobile objects

The smart controller uses the onboard or self-sufficient power supply, connects to multiple sensors and devices, defines current geographic coordinates in the GLONASS or GPS system, analyses, defends and transmits data through wireless channels.

#### 4. Individual households and “Smart house” systems

The Smart controller combines multiple sensors and energy management devices of the household in a single system for consumption accounting and equipment management.

#### 5. Profiles and power quality analysis

The device record the consumed energy statistics, current and network power, transmits it to the computer or to the cloud storage or store it in the volatile internal memory. The data is decrypted and analysed by special algorithms.

For example, the household defines which appliances (fridge, washing machine, kettle, oven, etc.) were used and what their contribution to the monthly electricity bill is. Based on this data, it's possible to formulate algorithms of operation for decreasing or redistribution of energy figures. In addition, it's possible to compare the numbers of the energy consumed from the equipment and from the meter that is used into account with energy supplier. The recorded data analyses the quality of electricity.



## 4.2. Energy buffering

Mismatch of generation peaks and consumption, failure to set power grid generation by consumption or backwards, failure to set consumption under the current production, explain the necessity of electricity buffering. This function is the principal benefit of the Powerchain platform in comparison with traditional power grids and determines its high level of balance.

Platform users can set energy accumulation tasks in their storage systems, which is then consumed by the user or sent to other members. Energy storage system is a “warehouse” and a source of energy for Powerchain platform members.

Active storage battery use allows the Powerchain platform to distribute the electricity production and consumption maximum efficiently and profitably for all members. To dismiss the generation operation wasting, the accumulators can get energy through the low network load, and deliver at the time of maximum loads with owner benefit.

The use of storage enables their owners to guarantee the power grid independence. The Powerchain platform allows them to profitably sell the energy surplus from the storage systems to other users. With a smart controller user can get an optimal mode of energy production and consumption.

Utilizing energy storage helps to make a concept of prosumer viable — member of the next generation power grid who is able to consume and accumulate energy.

### 4.2.1. Models of energy storage systems used on the Powerchain platform

Energy buffering operates based on several industrial solutions and depending on the requested parameters will rely on different storage systems types. In many cases, the use of hybrid storage battery systems is sufficient.

Within the platform framework, the network storage systems connection, in terms of its operation and its technical condition control, i. e. features security and predictability, is prioritized over the technical aspects.





The Powerchain platform allows to connect the most popular and demanded storage systems types to the network.

### **Acid storage batteries**

Acid-lead batteries is the oldest types invented in the XIX century. The work of lead-acid batteries is based on lead electrochemical reactions in the sulphuric acid solution. Today the most popular are Absorbent Glass Mat (AGM) and Gel electrolyte (gel) acid batteries types.

In the AGM storage batteries type, electrolyte-filled fibreglass are soaked within the electrodes placed between electrodes, which do not allow the electrolyte to flow out.

The acid batteries manufactured by AGM technology do not need maintenance and extra room airing. In addition, AGM batteries have a pretty small self-discharge current. Charged battery can be stored disconnected for a long time. The inexpensive AGM works perfectly in buffer mode with a discharge depth of no more than 20%. In this mode, they can operate up to 10–15 years.

The Gel electrolyte (gel) batteries differ from AGM because a substance of silicon dioxide is added in their electrolyte. In result, a solid mass is filling the space among the electrodes.

The gel batteries benefit is the capability to retrieve from the deep discharge condition faster. They are able to transmit more than 1000 cycles of deep discharge without any capacity loss, and better resist charge-discharge cycles. Since the electrolyte is in a dense condition, it's less susceptible to delamination on the component parts (acid and water).

AGM and GEL batteries are widely used as energy storage systems for renewable energy sources of small size, as well as reserve energy sources.

### **Lithium batteries**

The most popular storage batteries type, which is utilised in a variety of equipment, from mobile phone to aircraft and ships.

The development of electrical and hybrid electric vehicles has pushed the development of powerful & compact lithium-ion batteries. In addition to the lower weight and greater specific capacity they provide us with almost total utilisation of capacity, are also reliable and work longer.



The active use of lithium-ion batteries has been determined as excessive electricity sources for households. So in USA, Tesla Company actively distributes household Lithium-ion batteries.

In addition, lithium batteries are actively practised in personal electric vehicles.

### **Alkaline batteries**

Alkaline batteries differ from the acid electrolyte, which gave the name of this type of accumulators. In addition, being widely distributed in small household appliances (such as AA and AAA-known batteries), alkaline batteries can also be used in solar power plants.

Their significant benefit — the extended shelf life in the discharged state, which remains unchanged. The shelf life of alkaline batteries in rare usage can lead to 15 years. In addition, large-sized alkaline batteries are used in railway electrical transports and for operating electric forklifts.

Another excellent advantage of alkaline accumulators is the possibility to it use in extreme weather conditions (for example, in cold).

### **Hydrogen storage system**

One of the most modern types of batteries is based on the use of hydrogen reaction. Hydrogen accumulators are manufactured on the combined work of the electrochemical generator and cell water (hydrogen generator), have a density of energy more than 350 watts per hour/DM<sup>3</sup> and the time of energy recovery more than a day. The energy capacity of such an accumulator is set (and changed) by the volume of cylinders for hydrogen and oxygen. With the rise of the dispensed power capacity of the drive the specific density of energy increases to 600–900 watts H/DM<sup>3</sup>.

Hydrogen accumulators can be installed in a housing of the size of a standard electric transformer, with a self-ruling system for the production, storage and consumption of energy in one place, without extra fuel.

The power in hydrogen accumulators has a surprisingly long shelf life (several months). The hydrogen reservoir produces a constant and steady flow of energy at the time of supply. Hydrogen accumulators are capable to work in severe weather and climatic conditions, whether it is a tropical region or the extreme north.



### **Advantages of hydrogen storage system:**

- High efficiency (60 — 90%);
- Use of an inexhaustible source of energy — water;
- Compatibility with all sources of energy (solar, wind, hydro-power, etc.);
- Autonomous and full complex for production, storage and consumption of energy in one place (without additional fuel);
- A very long term of storage of energy for a period of several months;
- Continuous and reliable energy flow during power supply;
- Adaptation to difficult conditions: tropical region, salty environment, cold, wind, etc.;
- Compliance with field installation restrictions (small space, helicopter transport, remote control);
- Long life and environmental friendliness compared to batteries and generators: no carbon dioxide emissions, no noise from work;
- Low maintenance, remote operation and diagnostics;
- Intelligent control of energy production and consumption.

The partner of the Powerchain project, GOTOSOLAR company has the chance to provide reservoirs running on the hydrogen cycle (electro-chemical generators). We are forming a distribution system for these accumulators to offer the Powerchain platform members with the best options.

### **Kinetic energy storage system**

The Powerchain platform offers an innovative kinetic energy storage unit (NCE), developed by our partner, Kinetic.

Use of storage in a shared storage environment, communication with several types of energy consumption and renewal within the cloud



network matrix, several applications, including “intelligent” data processing systems, has created those new competencies by means of which it’s possible to record the volume of energy produced by generating nodes of any type and quantity of its consumption at any location or movement of consumers. The system will remember the actually produced energy, compare them with the determined data in kWh, and make an inference about the level of energy storage and its optimal distribution between the accumulators (NCE) and consumers to reduce transport losses and generation costs.

NCE allow to hold up to 90% of the platform members ‘ capacity with high rate of the crashes and virtually limitless cyclicality, as denied to electrochemical installations, restricted by a maximum of 15% of power balancing from the identical highest power capacity of the storage system, in turn which are good for long-term storage of energy with flat cyclical.

A strip super flywheel is used as the core element of NCE, the principal benefit of which is its unique safety in case of separation. The kinetic energy reservoirs have a number of advantages:

- 1) the high specific energy capacity of the system (especially volumetric);
- 2) the scalability of the system by changing the number of individual super flywheels;
- 3) no additional protective facilities are required during operation;
- 4) production of reasonably cheap and affordable materials;
- 5) the simplicity of manufacturing, including backspacing of super flywheel tape;
- 6) the possibility of using standard external industrial machines;
- 7) long service life;
- 8) wide temperature range of operation;
- 9) low cost compared to other types of storage



## Use of kinetic energy reservoirs

### 1. *Public electric transport*

NCE utilise energy regeneration technology, taking energy when braking the rolling-stock and returning it back to the contact network when accelerating trains without boosting the voltage in traction substations.

According to estimations of American experts, the complex implementing of similar systems of district lines and underground stations will save from 15 to 30% of the electricity consumed by trains.

### 2. *Personal (individual) electric vehicles*

NCE save energy from alternative energy sources or a vulnerable network for the following fast charge of electric vehicles.

It allows to place refills in any area and at any location of existing low-power networks, therefore increasing the sector of electric transport.

The energy platform is set to help customers build their own network of stations, in which already at the design stage the principles are set both technical and financial management of the infrastructure of charging stations based on the platform technologies.

### 3. *Alternative energy sources*

NCE accumulate and provide energy from alternative sources for the maintenance of power at short-term loss or termination of energy supply from an alternative source, or also transfer out a high power if needed.

It solves the problem of dependency on climate conditions and allows us to get the rank of a general power supply to consumers.

### 4. *Development of island technologies*

The use of green energy in NCE in order to keep power in combination with hybrid energy accumulation solutions (NCE in electrochemical accumulation technologies) can lead to the island, totally autonomous from the grid.



### 5. *Improvement of electric network quality*

Using a module consisting of multiple powerful NCE placed on the consumer side and synchronized with the platform can solve the problem of frequency adjustment as a frequency filter in public networks.

### 6. *Return of peak loads of large industrial plants and electrical networks*

NCE can solve the problem of compensation of peaks in grids at the intermittent use of high-power devices or at the start-up of the intense equipment, which leads to a short-term increase of power consumption at industrial plants and in electricity. At the time of the peak the central part of loading NCE takes over, and the power grids operate in regular mode.

### 7. *Provision of emergency power supply to especially relevant consumers*

NCE can provide electricity to industrial consumers during the short-term power blackout.

The ability of the accumulator to give out a short time of high power allows industrial consumers to launch backup generators, without stopping intensive production.

## 4.3. System security and reliability

### 4.3.1. Monitoring and predictive analysis of nodes

The Powerchain platform uses an advanced monitoring and analytic technology for all hardware nodes connected in the platform. This allows you to get reliable data about the current status and foretell the state of the connected equipment at the points defined by the smart contracts.

This solution allows you to define the current technical status of the equipment and foresee failure for several months or weeks in advance. Therefore, the user has the capability to prevent damage.



The technology of the technical state projection includes the device microprocessor system, the method of diagnostics and the system of production management (ERP as a complex of all IT-systems, providing work of the industry or organization). The microprocessor system consists of a collection of sensors located on the most relevant nodes of the analyzed equipment, from transducers of input signals, transducers of output signals and onboard computer.

The invention of the method is in the combination of science and technology: manufacturing models, forecast models and raw data for training are able to provide the best result to evaluate the technical status of complicated systems and high accuracy crash forecast.

To set the rules for detecting breaches of equipment operating modes and pre-failure events in telemetry own declarative language is formed.

#### **The system uniqueness:**

1. scientific solutions using computer education, methods of working with big data, neural networks, artificial intelligence and tools of extensive learning;
2. reliable forecasting for multi-parametric engineering systems;
3. identification of failure origins, which may not be detected by other systems;
4. modular and micro-service structure, which allows the platform to be flexible for integration with client's software and hardware systems;
5. the continuous study of the system by engineers with the help of computer training algorithms.

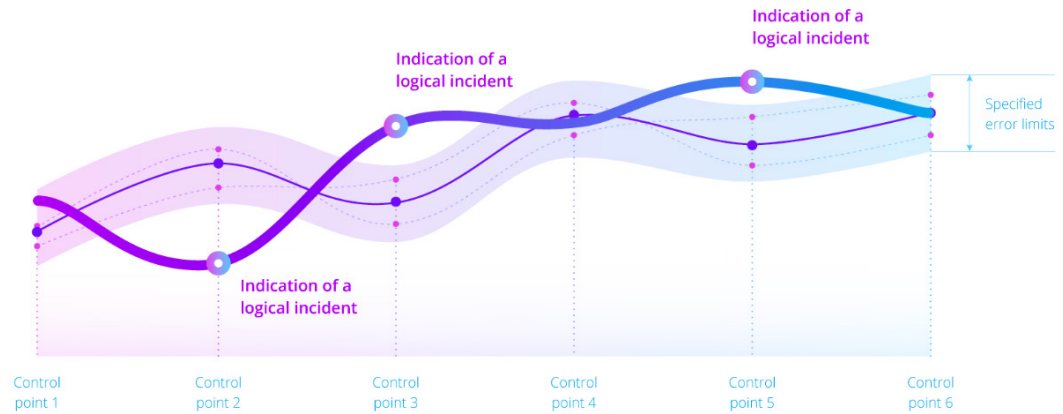
### **4.3.2. Business process forecasting**

Using the technology of monitoring and analytic of events and data streams that make up the platform's business processes allows forming an environment of "immunity" in which supply losses are impossible.

The solution is intended for designing software, the so-called Inforobot, which is embedded in the business process and doesn't allow differences from the standard caused by operational losses or fraudulent actions.



The business system consists of a list of conclusions emerging at several time periods inside the data systems after the process is managed by the Inforobot on the matter of changes in the content, function or behavior of the members business process.



This approach allows receiving the actual picture of the business process organization because the formal description of the case and its efficient implementation are significantly different.

In the process of building a representation of a real process, it identifies its vulnerabilities, creates control points, and recognizes triggers showing unusual actions, such a process cannot be “hacked”, even having unauthorized access to component monitoring or detecting a vulnerability.

As a result, Inforobot manages to identify and block the change from the process at the moment of its performance and block it, which fundamentally defines the approach from the existing solutions aimed at monitoring and research in the market.

Based on the usage of the key objectives of the process (application, invoice, contract, etc.) from the cloud of data events (activities in business applications, email, messengers, ACS, Smart camcorders, CRM, ERP, telephony, document flow, etc.) “Usual” series and “usual” intervals of these events are generated, corresponding to the actual life cycle of the process, which, as mentioned above, frequently differs from its formal description based on an interview or regulations.





An innovation in this approach will be the automatic computation of the predictive events, the changes of which are prerequisites for the violation of the process conditions and, as a consequence, to the resource losses and creation of the control system, at the stage of the pilot misspell revealed violations.

This method allows to bypass not only losses at internal breaches but also is “the latest line of defense” at external stealings. Even if you have control over your infrastructure and compromising accounts, hackers will not be able to perform anything other than those allowed by the Inforobot controller.

A significant benefit over other solutions is the embedding of internal controls in the “as it is” process, which adapts to all changes automatically.

### **4.3.3. Cyber protection**

The Powerchain platform built-in application protection during their life period, which is capable to block the cyber attack without human involvement. The protection system provides complete control of the application and infrastructure state for vulnerabilities and blocks the exploiting requests to them.

The system completely replaces the conventional tools of application security research (Sast, DAST, IAST, FAST) and current application protection (WAF, Sandbox, Antiddos, IPS), combining the essential functions under the control of artificial intelligence. This allows you to leave expensive and inefficient security monitoring centers (SOC), block any attacks on the network and application levels, and virtually exclude the human factor from security management.

#### **Technologies and methods**

This system uses fully recognized high-level technologies and own machine-based training and neural innovative technologies.

Through a whole spectrum of cyber response tools, artificial intelligence

automatically discovers the best approach to respond to the specific attack. Traffic analysis types, improved with knowledge of the vulnerabilities of the protected application, allow to reflect and “zero-day attacks”, that is unknown at the time of the attack and not having a usual response scenario.



The protected application is examined on vulnerabilities from the first minutes of encoding, and also at each modification of a functional, updating or installation of a patch. This allows you to identify and correct coding errors at the initial stages, which prevents the generation of functionality on vulnerable platforms. The multi-stage automated analysis procedure, which includes inactive, vibrant and interactive analysis, fuzzing and load reports, virtually excludes the prolific of vulnerable elements.

To compensate for potential logical errors that cannot be identified in the automated testing process, the system uses machine learning to discover the business logic of the application and blocks efforts to violate it even if legitimate user accounts are compromised.

DDos-Attacks (Distributed Denial of Service) on the services of the protected application is reflected “on the far approaches”, without waiting for a risky number of invalid requests, the compartment of attacking parts of the Internet network. For this mission, the international network of Qrator traffic clearing centers is used, which based on blocking the attack not on the target of the attack, when it requires substantial resources to receive and filter traffic, but at the start of the attack, when it can be reflected with small forces.

This method allows you to create an active robotic multilevel protection system that stops intruders from successfully attacking, as well as leveling possible errors of users and system administrators of the application.

#### **The system uniqueness:**

1. automated recognition and blocking of attacks as contrary to the standard procedure, which involves notifying the monitoring center about the attack and waiting for the administrator’s guidance regarding the response scenarios;
2. complete exclusion of the human factor;
3. reflection of all kinds of attacks by one solution (the usual way suggests separate products for each type of attack);
4. linear scalability — when the application load increases, the protection system requires only a gradual increase in resources;
5. a possibility of embedding in any industry and business system, as well as in any infrastructure, including virtual and cloud.



## 4.4. Mining modules (cryptocurrency mining)

We have developed and made for the production of new generation mining containers with a capacity of 1.3 MW each. They are based on ASIC BitFury and in addition to high computational power (HASHRATE  $\geq$  7.5 PH/s Bitcoin) have an extra option of immediate capacity overcoming and a unique environmental solution for heat recovery.

The mining modules are constructed in the form factor of the sea container. The series includes five main types of computational containers, outfitted with the market-specific evaluators (miners).

### Container types

1. based on SHA-256 ASIC BitFury (Bitcoin), hash-7.5 PH/s;
2. based on Nvidia GTX 1060 (Universal GPU-miners) video cards:
  - a) Ethereum, hash-41.8 GH/s;
  - b) Zcash, hash-501.6 kh/s;
  - c) Monero, Hash-1.358 MH/s;
3. based on script ASIC Bitmain (Litecoin), hash-302.4 GH/S.

### Advantages of Powerchain mining systems:

- can be delivered to the place by any transport mode, have the expected time of 2 working days for deployment or dismantling;
- equipped with disposal devices of high or medium voltage 110 or 35/10/6 kV and lowering transformer substations with low voltage delivery devices in container fulfilment;
- designed for the connected power from 140 kW to 1150 kW at a length of 6 to 12 meters;
- designed for running in different climatic conditions in the temperature ranges from  $-40$  to  $+38$  °C;
- have a pristine air cooling system-ventilation with street air with the heat removal to the environment;
- average annual power consumption on cooling for different versions is 4.5 — 15% of the payload capacity.



# 5. Powerchain Token (POWEC) and ICO

## 5.1. Economic model

Using your own POWEC token allows you to build a self-sufficient financial ecosystem that is supported and developed by the activity of the members.

Most cryptocurrencies are in a big demand but are supplied with nothing. Sadly, they are mainly utilizing the conflict within the decentralized system and the vertical-hierarchical matter. The development of the economic model by mining has its ceiling to reach the limit of the volume of emissions.

Unlike the “unsafe” cryptocurrency projects, Powerchain relies on genuine industrial assets and work with electricity and doesn’t provide for “speculative” alternatives of development or manipulation (forks, unsecured emissions, etc.).

The POWEC token will be made as a new kind of secured cryptocurrency. We consider the gross generating capacity of the community members and their storage capacity as one of the foundations for the security of their cryptocurrency.

However, the system of member communication cannot be isolated from the current cryptocurrency with which the maximum cooperation will take place.



## 5.2. POWEC Token

POWEC — an ERC20 token issued on Ethereum blockchain for making all transaction within the Powerchain ecosystem. It's provided with the collective production and storing potential of the platform, as well as its capacity for generation, storage, distribution and smart consumption.

The cost of POWEC will be affected by the number of platform members, their total production and storage capacity, as well as the volume of electricity services.

## 5.3. ICO terms

**Token name:** POWEC

**Total supply:** 100 000 000 000 POWEC

**Reception currency:** BTC, ETH, USD, EUR, RUR, etc.

**Softcap:** \$75 million

**Hardcap:** \$210 million

**ICO Terms:** Q2'2019

**Token Price:**

- Presale (Pre-ICO): €0.005
- Sale at ICO: €0.025 (0.00005 ETH)

**ICO stages:**

1. Seed-funding (early birds): Earlier offer
2. White List (Pre-ICO): Pre-sale
3. ICO: Core Sale

**Minimum contribution:**

- or \$100'000 on the stage pre-ICO (White List)
- or \$10'000 at the ICO

**Maximum contribution:** none

**Token distribution:**

- 60% — ICO
- 10% — Reserve fund (payments for the first miners)
- 20% — Team (vesting for 3 years)
- 5% — Advisers (vesting for 1 year)
- 5% — Development and marketing, including airdrops and bounty

**Distribution of collected funds:**

- 20% — marketing and partnerships;
- 10% — legal expenses;
- 10% — administrative expenses;
- 20% — business development;
- 30% — product development;
- 10% — operating activity.

**ICO stages****Seed-funding (early birds) — Earlier offer**

It is discussed in an individual order.

**White List (Pre-ICO)**

- Token supply for sale: 12 billion
- Price of Token: \$0,0025
- Target sum of proceeds: \$30 million

**ICO**

- Supply: 15 billion
- Minimum target sum of proceeds \$50 million
- Maximum target sum of proceeds: \$150 млн
- Price of Token: \$0,01

**Bonuses:**

- Week 1: +20%
- Week 2: +18%
- Week 3: +16%
- Week 4: +14%
- Week 5: +12%
- Week 6: +10%
- Week 7: +8%
- Week 8: +6%
- Week 9: +4%
- Week 10: +2%

Token is mintable. It means after all tokens have been distributed we close the contract and no other tokens can be issued.



# 6. Road Map

## 2016

Project concept development. Completion of the research and development process (R&D).

## 2017

First use cases (JSC "Russian Railways", "St. Petersburg Underground"). Patents obtained.

## 2018

**Q1.** Team building, platform architecture development.

**Q3.** White Paper release. Seen-funding.

**Q4.** Platform development, legal issues, negotiations with power grid companies. Deployment of network nodes and national energy centers. Platform beta testing (by invitation).

## 2019

**Q1.** The release of the platform MVP. Deploy and test smart contracts. Testing the Blockchain network platform.

**Q2.** Active promotion of the project, increasing the number of network members. Pre-ICO and ICO holding.



**Q3.** Tokens distribution among ICO participants. Listing token on crypto exchanges.

**Q4.** Platform testing and auditing, protocol certification. Platform deployment, pre-release.

## **2020**

**Q1.** The Powerchain platform release.





# 7. Team. Advisers. Partners

We have created a dream team: decentralized, distributed across countries and even continents, with unique practical experience and expertise in all significant areas of our project.

Our experience involves working with existing industries that working in the sectors of the actual economy and authentic areas: energy, transport, oil and gas sector.

Implementation of the Powerchain project is impossible without our expert advisers, recognized industry experts, reliable partners and experienced team members.

## 7.1. Team

**Zotov Alexey**  
*Founder and CEO*

In 1990 he graduated from the Leningrad Institute of Precision Mechanics and Optics.

Since 1990 began to engage in private entrepreneurship.

In 1997 he started working in the bank "Inkombank" as the Head of strategic projects management.

Since 1999-Head of the department on work with clients of bank "Baltonexim".



In 2000–2001. He served as vice-president of “inter regional clearing bank” and “Alfa-bank”.

In 2006 he was the Director of Railway business of the Russian machines company.

In 2006–2010. — Chairman of the Board of Directors of Companies “Russian Transport Engineering Corporation” and “Abakanvagon”, member of the board of Directors of the S7 Group of companies, Executive Director, Chairman of the Board of Directors of the Company “Integrated transport System “. He is an active member of the Association of independent directors.

In 2009 — Senior vice-President, director for development of large corporate business “Alfa-bank”.

Since 2011 — First Deputy Director General of the Moscow Ring Railway (MRSR).

In 2014 he was appointed to the position of general director of “MRSR” company.

In August 2016, he became deputy general director for the corporate order of the “Locomotive Technologies” company.

### **Bobrov Vladimir**

*Co-founder and Chief Financial Officer (CFO)*

Vladimir Bobrov has more than 20 years of experience in risk management and financial field.

He worked as the Deputy Director General of the Moscow Ring Railway Company for 5 years, a joint venture of Russian Railways and the Moscow City Hall, established to launch the transportation of passenger electric trains in Moscow The central ring.

General Director of the company Kinetic since its foundation in 2011. The organization is engaged in the development of innovative kinetic energy storage for energy companies of JSC “Russian Railways”.

More than 10 years he held key positions in the field of financial management in the group “Energomash”, participated in the construction of a network of gas turbine power plants with a total capacity of 550 MW.



For more than 3 years he worked in commercial banks in Moscow in the direction of intercommunication with foreign exchanges and money markets.

## **Mogilev Kirill**

*Co-founder and technical director*

In 1985, he graduated from the State Academy of Management. He served as a leading engineer, Head of the department in Engineering Institutes.

Since 1992, he has been engaged in organization and development of the business.

He was the General Director and co-owner of a number of successful international companies, including in the field of development and production of high-tech superconductors. Also, took part in the creation of technological equipment for industrial production of superconductors under the international program ITER. He has extensive experience in project and crisis management, working with international partners.

Since 2011 he has been managing the project on creation of kinetic energy accumulator "Kinetics".

## **Gulia Nurbej**

Russian scientist and inventor in the field of flywheel energy storage, infinite mechanical drive, hybrid transport power units. Doctor of Technical Sciences, professor, academician of the International Academy of Ecology. For more than 30 years he worked actively in patent conduct — in the Supervisory Council and Expert Council under the Chairman of The State Committee for Inventions and Discoveries of the USSR.

In 1964, still in the course of writing a PhD thesis, Gulia applied for the invention of the world's first intensive and burst-safe super flywheel. In 1973, he received his doctorate.

From 1977 to 2015 Gulia worked at the Moscow State Industrial University, first professor, then head of the department. There Gulia continued to engage in flywheel energy storage for transport, as well as began to develop CVT mechanical actuators-variators, necessary together with flywheels for car hybrids.



N. Gulia is the author of more than 400 inventions, about thirty books and hundreds of popular scientific articles. It holds the 25th place in the open ranking of Russian scientists in the history — “Scientists and inventors of Russia”.

### **Lavrentiev Alexander**

In 2010, he graduated from the Moscow State Industrial University (MGIU). Qualification is an engineer. The main specialization is transmissions of machines, energy storages.

Author of more than a dozen inventions and scientific articles, participant and prizewinner of scientific conferences and exhibitions, including international.

Works as a developer of automotive flywheel energy storage projects for a hybrid power plant with the wide-range transmission, energy storage for aviation applications, as well as test stands for energy storage. He is the author of various test methods, calculation programs on kinetic energy storage devices. He has experience in the design, production, testing and completion of friction variators, gears with separation of power streams, integrated electric drive, power electronics and automation. He graduated from the courses on the electrical safety of industrial plants..

## **7.2. Advisers**

### **Dmitriy Solodukha,** *chief consultant*

He has been working in solar energy since 2002. Started his career as a technologist, in 2008 began his own business selling equipment for solar power plants.

Since 2011 he is the head of the company **Unisolex** ([unisolex.com](http://unisolex.com)), which is engaged in the development, design and implementation of projects for the construction of solar power plants around the world.

He cooperated with Russian, European and Asian investment funds. Participated in the development of a project for the construction of



solar power plants with a total capacity of 270 MW in Russia. Founder of the companies **GOTOSOLAR** ([gotosolar.fund](https://gotosolar.fund)) and blockchain project **Solar DAO** ([solardao.me](https://solardao.me))

## 7.3. Partners

### **Kinetic**

The company “Kinetics” was founded in 2011 and is engaged in development and promotion of energy storage systems based on super flywheel technology. The company has received several scientific patents for a new kind of drive — kinetic energy storage. The team “kinetics” includes highly qualified specialists with many years of experience in the field of flywheel energy storage.

### **Atlas Energy**

A company belonging to the Nord Systems group. Develops core competencies of the group in the field of creation and support of industrial digital models (IT 4.0) on the basis of more than 20 years of successful work in the sectors of energy and transport.

The group’s specialists designed and launched more than 50 centers of integrated operations and situation analysis centers for oil and gas companies.

Was selected in a separate legal entity in 2015 to work in energy projects.

### **Clover Group**

Clover Group is a company for the development of data mining solutions with the use of artificial intelligence and neural, big data analytic for industrial enterprises in different industries.

The company cooperates with the largest enterprises of Russia, CIS, Europe, Middle East and Asia.

Provides the Powerchain project with a technology of operation monitoring and forecast of the technical condition of the equipment.



## **beClever**

A group of companies that is responsible for creating software solutions ranging from palm applications to key platform modules.

is a Microsoft contractor and has participated in the production of a number of well-known technological products.

## **3N INFOROBOTS**

The leading Russian team for the development of IT 4.0 structure for large national and corporate customers.

The solutions of the team assure the security of business processes based on the methodology defined on the principle of interaction between the biggest federal corporations ("Russian Post", Sberbank).

The development is based on the system of predictive data analysis, the building of distributed computing networks and neural to work with strong data flows.

For the Powerchain project, the company provides Inforobot technology which gives immunity to anthropogenic (actions of the subject) threats.

## **Attack Killer**

The company is part of the InfoWatch group. Its solutions protect the platform from all kinds of internal and external cyber.

has developed and promoted several unique solutions that have been integrated into the Powerchain platform, in particular, solutions for the protection of critical objects of national power systems, as well as complex security systems for Objects of type Smart City.

InfoWatch Company was founded in 2003 by Natalia Kaspersky. The company has grown from the internal project of Kaspersky Lab. Currently, InfoWatch is developing solutions to protect a business in cyber security and business processes. The company consists of 20 units in Russia, Germany, Belarus and Malaysia.



## **GOTOSOLAR**

Company Gotosolar is the operator of the blockchain project Solar DAO. Solar DAO is a foundation for Ethereum blockchain, which allows you to participate in solar power plants' construction with any amount. The community interacts within smart contracts.

Gotosolar is engaged in the projects development and attraction of investments in them. The projects of the fund include development, engineering, design, selection of equipment. Gotosolar individually selects the sites for installing power plants in different countries, which saves in the long run.

In the Powerchain project, the Gotosolar Foundation acts as an independent consultant on the use of blockchain in the energy sector. It provides key competencies and helps in integration of accumulation systems with generators based on RES.

## **Advanced LED Systems**

Advanced LED Systems is a Russian manufacturing company that produces light technical products using LEDs and software and hardware systems for management on the basis of brand-new technologies to enhance energy efficiency and energy conservation.

Developed solutions differing from the cosmodrome management system to the federal fiscal registrar. Innovative solutions of the company on the basis of LEDs are applied in medicine and agriculture.

The team creates unique software and hardware solutions in the field of PCs.

Advanced LED Systems is the creator of the smart controller, a primary control for the Powerchain platform network nodes.

## **Telecore**

The leading Russian company in the field of technologies and solutions for cryptocurrency mining. The company creates and implements both single miners and industrial range solutions.



The company provides hosting services for miners, development and assembly of modular solutions, as well as combined packages, including computational servers and ready-made engineering solutions for electrical and power supply, as well as references for installation and connection.

For the Powerchain project, the company provides the technology of mining containers for backup generation.

## **Walletworks**

The company, which was one of the first to propose the idea of industrial blockchain platform and created a comprehensive platform solution for applications in various areas of the economy.

Walletworks is a strategic adviser to the Powerchain project for the development of a specialized energy solution.

## **KEST GmbH**

A German company (2016), engaged in the production and development of energy technology, based on advanced analysis and engineering study.

Kest GmbH has a great expertise in the field of technical solutions in the field of electric power accumulation and storage. One of the latest developments in the creation and implementation of kinetic energy storage based on the use of super flywheel as energy accumulation/storage element for distributed power grids.

The company's philosophy is to search for innovative solutions of energy accumulation and storage for the development of electricity market, RES market in particular.

[www.kest-gmbh.com](http://www.kest-gmbh.com)





## 8. Legal Disclaimer

The purpose of this document is to represent the **Powerchain** project to customers whom the company Powerchain Energy Oü (hereinafter referred to as “the Company”) offers, in accordance with SAFT (a simple agreement for future tokens), the right to obtain **POWEC** tokens to be issued by the company for further use on the **Powerchain** project platform.

Potential buyers can find useful information in this document to address the issue of the practicability of using SAFT.

Each prospective buyer should take SAFT in full compliance with all corrections and changes that may be made to the document at times.

Tokens and SAFT are not registered and will not be registered in the United States (according to the Securities Act of 1933), nor in other countries under the laws of their jurisdiction. SAFT should be offered and sold under section 4 (2) (a) of the Security Act and in accordance with resolution (d), persons who are not U. S. citizens and cannot be purchased for U. S. citizens, as stated in Rule S, of the Security Act.

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# POWERCHAIN

A Peer-to-Peer Virtual Power Plant

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