Preface

The modern world community has a number of distinctive tendencies, one of which is population growth and the resulting growth in the consumption of food and goods that support the livelihoods of people. And this growth is due not only to the increase in population, but also to the increase in the level of consumption by each person. To meet these requirements along with a large number of measures of a different kinds constant involving in economic circulation of new lands and territories, suitable for the economic activities organization is required

As a rule, these territories and pieces of lands disposed far of main population's activity and in the same time from centralized centers of energy supply. The most suitable activity for these territories is agriculture.

Start a business in such territories is easiest if you are engaged in the production of agricultural products on small-scale enterprises, with a small number of employed people. Small scale production makes it possible to quickly deploy work, easier and faster to ensure the sale of products.

Such activities require special technical support measures both for the livelihood of people living there and for organizing a highly efficient and cost-effective production process. Naturally, in such territories it is easiest and quickest to deploy activities related to the production of agricultural products. Such enterprises are easier to provide with energy resources, in particular, using renewable energy sources.

Existing technologies of energy supply, cropping and processing of crops cannot always be easily adapted to use in small and medium-sized enterprises.

There was such a situation that information of this kind is needed not only directly by the worker in the village. The manufacturers and developers of such technical facilities and technologies and scientific organizations that are engaged in the development of technologies and equipment for the power industry of the village, production processes of various types, as well as the problems of housing and communal solutions, are showing great interest in new efficient means of conducting agricultural business, especially on a small scale, problems of the rural population.

At the same time, the implementation in practice of new technologies, both renewable energy sources and agro-production technologies at all production stages, has a number of barriers and obstacles, for the overcoming of which it is necessary to carry out a complex of scientific research or experimental design work. Their implementation requires a lot of money and time.

Significantly accelerate these processes may be by using modern approaches such as Intelligent Computing, including such approaches as Artificial intelligence, Quantum computing, Artificial Neural Networks, Self-Organizing, Fuzzy logic, Membrane computing, Evolutionary computation, Learning theory, Probabilistic methods, Image processing Computer vision etc., and Optimization, comprising

such approaches as Ant colony optimization, Artificial bee colony, Artificial immune systems, Artificial neural networks, Automatic computing, Bacterial foraging, Combinatorial Optimization, Computational intelligence, continuous optimization, Cultural algorithms, Direct Search, Fuzzy optimization, Hybrid algorithms, Local and global search, Memetic algorithms and many, many others.

It seems advisable to apply these approaches for the promotion of new technologies mentioned above, that's why it would be advisable to present and consider new technologies abilities through above mentioned computerized approaches gathered together in one book.

The book includes a description of a series of case study for investigation of new technological methods and technical means that ensure the organization of production of various products with application of above-mentioned computerized approaches, optimization and modeling processes what should permit to accelerate and make cheaper the way from new idea to its practical implementation. The main attention is paid to the specified technologies and technical means adapted to application in production of small scale, at the enterprises of small and medium business. Ways for accelerating of implementation of new technical solutions designed to provide vital activity in new territories with a high level of comfort and high standards of living conditions are also in some degree considered. Modern technologies of energy supply of life and production activity at remote, first-time territories are also considered through the prism of optimization and computing modeling. Definite attention is paid to works aimed at organizing an efficient production process and social comfort in the face of scarcity of energy resources and the need to rationally use them.

The book includes 18 chapters.

Chapter 1 discusses various phase-transition heat-accumulating materials. Their application in heat pumps and their use for heat supply are presented. Phase-transition heat-accumulating materials in heat pipes are also considered, various types of heat pipes are presented. The installation of heat storage with phase-transition materials is presented. Along with phase-transition heat-accumulating materials, the chapter considers thermochemical heat-accumulating materials on the example of photochemical reactions of energy storage. As an example of a thermochemical heat-accumulating material, a solar power plant for thermochemical energy storage is presented. Developed computer program for the description of thermochemical reactions allows describing chemical and thermochemical reactions in multicomponent reciprocal systems, which can be carried out in the course of the reciprocal multicomponent systems. Computer program allows identifying thermochemical reactions occurring in mutual multicomponent systems, regardless of component and depending on temperature.

Chapter 2 is dedicated to the consideration the results of research of ozone treatment of vegetable storehouses with the use of ozone generators with barrier and corona types of discharge, and reveals factors affecting disinfection process. As it is known, ozonation of fruits and vegetables may increase their storage life nearly twice. It has been found out that ozone concentration depends on dynamic balance of the two basic processes – ozone-air mixture supply and ozone decomposition. Formulas for calculation of the ozone generator capacity in the recirculation mode have been derived. The automated system for control of disinfection process in vegetable storehouse is described. Experimental test has shown that ozone effect is long-term and efficiency of sterilization of surface contaminated with microflora amounts to 100%.

In Chapter 3, intelligent data analysis techniques such as data mining or statistical/machine learning algorithms are applied to diverse domains, including energy informatics. These techniques have been successfully employed in order to solve different problems within the energy domain, particularly fore-

casting problems such as renewable energy and energy consumption forecasts. This chapter elaborates the use of intelligent data analysis techniques for the facilitation of renewable energy monitoring and forecast. First, a review of the literature is presented on systems and forecasting approaches applied to the renewable energy domain. Next, a generic and large-scale renewable energy monitoring and forecast system based on intelligent data analysis is described. Finally, a genuine implementation of this system for wind energy is presented as a case study, together with its performance analysis results. This chapter stands as a significant reference for renewable energy informatics, considering the provided conceptual and applied system descriptions, heavily based on smart computing techniques.

Chapter 4 considers optimization of sectionalization parameters of distributive electric networks. Reliability of power supply of electricity consumers depends on the presence of sectioning devices in distribution electrical networks. Determining the number and installation sites of sectioning machines is an important optimization problem, based on a comparison of the cost of installing devices and reducing the damage to consumers from undersupply of electricity. A mathematical model is proposed to determine the cost-effectiveness of installing partitioning switching devices for networks with means of increasing reliability. The possibility of using when choosing a place to install switching devices not only an economic criterion (in the form of reducing damage to the power supply system as a whole), but also a criterion that takes into account the change in the duration of downtime of certain consumers is indicated.

Chapter 5 discusses the simulation of thermal operating conditions and the optimization of the design of solar photovoltaic thermal modules. As a realization of the developed method, two photovoltaic thermal modules with one-sided solar cells with one-sided heat removal and two-sided solar cells with two-sided heat removal are presented. The components of the developed models of solar modules must be optimized on the basis of the required indicators of the thermal mode of operation of the modules. For this task, a method has been developed for visualizing thermal processes using the Ansys system of finite element analysis, which has been used to research thermal modes of operation and to optimize the design of the modules created. With the help of the developed method, the temperature fields of the module components, coolant velocity and its flow lines in the developed models of a planar photovoltaic thermal roofing panel and a concentrator photovoltaic thermal two-sided module are visualized.

Chapter 6 analyzed various methods of gainful utilization of excess heat from power transformers. The ways to reduce heat loss inside the tank power transformer are found. The potential amount of heat emitted by power transformers of different capacities is calculated. New ways of combining the functions of electric transformation and heating in a power transformer are described. A system has been developed to use the excess heat of power transformers in the agricultural power systems. There are the structural and schematic diagrams of the system and a method for calculating its main elements. An improved design of the power transformer cooling system has been developed to combine the functions of electric transformation and heating. Experiments to verify the effectiveness of decisions are described. A feasibility study of the implementation of the developed system was carried out.

Chapter 7 considers a system of principles and approaches for studying processes of microwave-convective grain treatment. The essence of this research is described starting from the initial phase of designing structural diagrams of technological processes. Based on the explicitly defined process target, functional-physical analysis has been performed that made it possible to specify the most essential factors of process. The morphological analysis of the processes was carried out in several stages. At each

stage, the specification of the goal and excluded variants of factors that at this stage, the development is impractical to implement. It is advisable to carry out a check of the effectiveness of the options selected from the morphological table using modeling. To this end, developed mathematical and computer models of the process. The results of modeling the drying of grain in the microwave - convective zone confirmed the feasibility and efficiency of using the obtained model.

Chapter 8 considers obtaining and using of biogas in agricultural production. In recent years, an increased interest has been shown in fuels derived from renewable energy resources of animal and vegetable origin, the raw materials of which are practically unlimited. The use of biofuels makes it possible not only to replace petroleum motor fuels with alternative ones, but also to improve exhaust gas toxicity indicators (as a rule, there is a marked decrease in emissions of toxic exhaust gas components). This work is devoted to the study of the possibilities of solving these problems in order to adapt diesel to biogas, a theoretical study of ways to create an experimental model of a power plant for generating electricity from biogas, a theoretical study on the processes occurring in the main components of the plant being developed and the creation of this plant.

In Chapter 9, the authors reveal the relevance of modeling electrohydraulic technology in terms of determining the parameters that cannot be measured by existing methods and technical means. The purpose of the chapter is modeling of electrohydraulic technology in agriculture. By modeling, the authors are developing an installation for obtaining nutrient solutions under irrigation conditions in order to increase the yield in greenhouse vegetable combines while ensuring the environmental friendliness of the process. We used the methods of research, analysis and calculation of technical means and control systems applied to high voltage electro technological installations of agricultural use. Mathematical patterns are established, and a logically based relationship is established between changes in electrical conductivity of water as a result of electrohydraulic processing.

Chapter10 is dedicated to consideration of rational placement plants on the field area by seeding machines (methodical aspects assessment rationality). Any harvest is primarily the realization of the potential productivity of plants in certain conditions, depending on the parameters and operating modes of the sowing machine. The result of the operation of mechanized sowing will be the parameters of the nutrition area of each plant is the shape and numerical value of these area. The resulting schemes of plant placement on the field correspond to certain characteristics and parameters of the areas of plant nutrition, determining the availability of all elements of mineral nutrition, photosynthetically active radiation and the relationship of units of agrophytocenosis. This is one of the decisive conditions for the harvest. The development of theoretical ideas about the uniformity of plant placement and the use of appropriate criteria and characteristics will create the necessary understanding of the role of the sowing machines in crop production during cultivated plants in the framework of mechanized technology.

Chapter 11 considers very interesting question: how to manage the effectiveness of presowing treatment of seeds. Variants of seed response to external disturbances were studied to determine the principles that should be followed during pre-sowing treatment. The approach that involves analysis of seeds' adaptive response has been applied. The basic organizational rules have been specified for external disturbances application to seeds. The use of informational method for studying biological response of seeds on external actions made it possible to find the rules that have to be followed when pre-sawing treatment is performed with the use of electrophysical excitation. The essence of these rules is that the following sequence of operations shall be carried out in the process of pre-sawing treatment: to define

the lowest energy level of external disturbance corresponding to seed's sensitivity threshold, to organize cyclic action of external fac-tor on seeds, to vary the amplitude of external factor within cycles, to vary the mode of external disturbance. Field experiments were carried out for several years, during which the presowing treatment of seeds was determined.

Chapter 12 is dedicated to consideration Lévy-Enhanced Swarm Intelligence for optimizing a multiobjective biofuel supply chain. Engineering systems are currently plagued by various complexities and uncertainties. Metaheuristics have emerged as an essential tool for effective engineering design and operations. Nevertheless, conventional metaheuristics still struggle to reach optimality in the face of highly complex engineering problems. Aiming to further boost the performance of conventional metaheuristics, strategies such as hybridization and various enhancements have been added into the existing solution methods. In this work, swarm intelligence techniques were employed to solve the real-world, large-scale biofuel supply chain problem. Additionally, the supply chain problem considered in this chapter is multiobjective (MO) in nature. Comparative analysis was then performed on the swarm techniques. To further enhance the search capability of the best solution method (GSA), the Lévy flight component from the CS algorithm was incorporated into the GSA technique; developing the novel Lévy-GSA technique. Measurement metrics were then utilized to analyze the results.

In Chapter 13, multi-criteria evaluation of reconstruction strategies for distribution power networks designed for rural power supply is considered. The deterioration of rural distribution networks now exceeds 70%. This is due to the high failure rate of electrical equipment, high maintenance costs, reduced power quality and increased duration of power outages in agricultural production. This leads to a short supply of electricity, downtime of process equipment, loss of production or production of low-grade products, as well as excessive energy losses during transmission. An important issue is the development of advanced methods for assessing the feasibility and effectiveness of component replacement of power transmission equipment with new and modern, providing a reduction in electrical energy losses in distribution networks. To solve these problems, various strategies have been developed and studied to improve the reliability of 10 kV overhead power lines by reconstruction using modern insulators, wires and supports, which are the main components of rural power grids.

Chapter 14 considers video capsule management of agro-technological processes (Video capsule Management. Nowadays agricultural production has had (unused) unclaimed information and management resources for the development and improvement of agro-technological processes and service of agricultural enterprises so far. New opportunities to improve the comfort and intelligence of labor can be provided in the design of management systems geographically distributed agricultural production using mobile and remote video surveillance, unmanned video service automation, video bots, remote web clients-included in a single integrated system of self – organization of agricultural enterprises.

Chapter 15 is dedicated to consideration of modern methods of optimization in models of hydrothermal coordination and emission of contaminating particles in power generating plants. In the chapter authors describe succinctly the structure of a mathematical model that defines the popular problem of planning the operation of a hydrothermal system in the short term. In particular, we are interested in addressing some of the different ways in which it is presented in real contexts, the authors and the modern methods used for its optimization. One area of special emphasis is the constraints associated with it as well as its meaning. Finally, we present an application case or instance where we compare two totally opposite methods for the solution the same: 1) a simple finite search algorithm and 2) the well-known search method using Genetic Algorithms. We also make an approximation to the particle emission model consistent with the system operation plan. We hope to contribute to the subject.

Chapter 16 considers a model for planning the sowing of agricultural crops and raising animals through two-stage mathematical programming. In this chapter a proposal is developed which finds the optimal scenarios associated with a problem of planting vegetables and raising animals under an environment of uncertainty. The model is developed under different contexts explaining the models derived from each decision under the ``Here and now'' scheme. The results of the model are reported, and the models illustrate the way they are obtained. The uncertain parameters of yield amount and price level are calculated using real data. We present an instance that illustrates the use of the two-phase program of allocation applied to the distribution of land and the allocation of livestock raising areas. The variants presented here correspond, firstly, to deterministic linear structures for the case of the management of animal diets and, secondly, to linear stochastic programming models in two phases for the problem of land distribution and allocation of areas for the raising of cattle. The uncertainty of the model is given in terms of rainfall and the availability of water and food for the crop and cattle respectively.

Chapter 17 describes theoretical studies of the influence of the elastic-damping mechanism in the tractor transmission (on the functioning of the machine-tractor unit). It presents a mathematical model of the machine-tractor unit with an elastic damping mechanism, which is installed between the engine and the tractor transmission, when performing agricultural operations (sowing). The description of work of EDM (elastic damping mechanism) shows its advantages. The theoretical influence of the transparency degree description on the machine-tractor performance unit on sowing operation is also given. The dependence of transparency degree graph on various agricultural operations depending on frequency of fluctuations of traction loading of P and at various works for a tractor is given. The purpose of this work is to conduct theoretical studies of the influence of the elastic damping mechanism in the tractor transmission on the performance of the sowing unit. The optimal parameters of the elastic-damping mechanism installed in the transmission of the tractor for sowing operations are determined. The substantiation of expediency of installation of the elastic-damping mechanism in the tractor transmission when performing the sowing of grain crops is given.

Chapter 18 presents the results of the development of two systems. The first is a photovoltaic system parallel to the power supply network of led lamps. The algorithms of the system operation for both working and emergency lighting are shown. The basic operating modes of the system are considered taking into account the criterion of the minimum cost of electricity generated. These modes provide the most complete use of solar energy in the working day with minimal additional costs, allowing the consumer to save on electricity and increase the reliability of the emergency lighting system. The second system is a solar photovoltaic module built into a standard double-glazed window (730x700 mm), which is designed to charge a block of lithium-ion batteries with a capacity of 6.8 Ah with an output voltage of 5.25 V, the energy of which can be used to power any device having a USB 2.0 connector. The results of calculation of the required peak photovoltaic power of the module are presented; the technology of its sealing is described.

The book is intended to a wide range of persons, such as students of power and agroengineering specialties, experts and heads of municipal unions, managers of the ministries and other organizations responsible for development of agrarian industry, the businessmen dealing with such a business and many others as for organizations like big consortium, Inter-regional public organization for assistance to advancement of new technologies in social sphere "Sustainable development"

The editors strongly believe that the information got out of the book will undoubtedly be interesting and useful for a wide circle of readers from starting students to famous scientists. This edition should provide dissemination of rather new information among interested scholars, engineers, professors and students involved into the agro-engineering industry as well as in smart computing and optimization activities in different fields of science and engineering.

Valeriy Kharchenko
Federal Scientific Agroengineering Center VIM, Russia

Pandian Vasant
Universiti Teknologi Petronas, Malaysia