

Preface

INTRODUCTION

Nowadays circumstances year by year puts forward new problems and challenges. Mankind food and other vital goods consumption steadily grows. To meet these requirements constant involving in economic circulation of new lands and territories, suitable for the economic activities organisation is required.

As a rule these territories and pieces of lands disposed far of main populations 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.

An important issue is the organization of reliable power supply in an autonomous mode. The use of renewable energy sources can play an important role in this issue. And this means that information on the possible technologies of autonomous generation of electric and thermal energy, its rational consumption through the use of energy-saving technologies will inevitably be in demand. Of great importance in the organization of active activities in rural areas can also be the use of intensive technologies for the cultivation of products and its processing on site with the least expenditure of energy, the amount of which at remote sites may be critically small.

OBJECTIVE OF THE BOOK

The book includes a description of a series of technological methods and a number of technical means that ensure the organization of production of various products in the territories newly allocated for economic activity or cultivated for these purposes. The specified technologies and technical means are adapted to application in production of small scale, at the enterprises of small and medium business.

Technical solutions designed to provide vital activity in new territories with a high level of comfort and high standards of living conditions are also considered.

Modern technologies of energy supply of life and production activity at remote, first-time territories are considered.

Much attention is paid to work 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.

It is an obvious fact that any similar published books compiled altogether issues of rural business development concerned in the intended mode doesn't exist. No doubts that the book being published attract attention of a huge number specialists related to rural agribusiness activity on remote territories and looks to be very interesting for wide range of practical managements and businessman as well as scientists involved in activity connected with considered in the book technical field.

The particular interest to the book may be connected with the fact that the materials represented in the book, mainly was not published in English yet and consequently was not available for readers throughout the world.

TARGET AUDIENCE

The book will be useful to a wide range of persons, such as students of agro-engineering and power specialties, experts and heads of municipal unions, managers of the ministries and other organisations responsible for development of new territories, the separate large businessmen beginning business at new territories and many others as for organisations like large international consortia specializing in various business in rural areas, primarily related to but not limited to the production of agricultural products, including food. A very useful book will be for small commodity producers in the countryside, various entrepreneurs of medium and small businesses as well as for inter-regional public organizations for assistance to advancement of new technologies in social sphere in view of environmentally friendly sustainable development. In general the book is intended for representation of the wide public advanced achievements in the field of agro-engineering and related to the rural business energy technical means which will be useful to a wide range of readers and doubtless positive impact on a solution of a problem of a sustainable development of new rural territories.

Topics reflected in the book:

- Solar thermal energy installations
- PV solar power plants for rural objects energy supply
- Wind based energy generation installations and systems
- Cogeneration PV thermal modules fabrication and application
- RES application best practices in agriculture
- RES potential in remote territories of different countries

- Specific RES potential evaluation methodologies in condition of meteo data absence
- Providing parameters of solar power plant with given generation graph
- Innovative compact controlled electricity transmission lines
- Resonant Power Systems for Renewables based Electricity Grids;
- Resonant system for efficient electricity transfer
- Energy saving system for illumination of greenhouse plants
- Energy efficient electric equipment for heat supply in Agriculture
- Scientific and methodological support of rural electric system operation
- Solutions for diesel, wind and solar power plants joint use

The material presented in the book is devoted to the presentation of the results of theoretical and experimental research in the field of renewable energy sources. Devices, technologies and examples of practical use of systems based on renewable energy sources are considered.

Part of the book is devoted to the consideration of the issues of energy supply of agricultural production and household aspects of life in rural areas, including both heat and electricity supply.

It is necessary to note the fact that a significant amount of the material presented in the book is devoted to works made in different countries, but not published in English. This will allow the English-speaking reader to get to know them. The creators of the book hope that these sections of the book will be useful to English-speaking readers and will be in high demand.

The Chapter 1 dedicates to consideration of concentrators of solar energy with use concentrators based on holographic films. Looking at the history of solar energy and renewable energy in general, the authorities and scientists have been paying much attention to the recent period, due to the depletion of fossil energy resources and the growing difficulties in solving environmental problems. The development of solar energy technologies has led to the use of solar energy concentrators. Concentrators use to concentrate sunlight onto PV cells. This allows to provide for a reduction of the cell area required for producing a given amount of power. The goal is to significantly reduce the cost of electricity generated by replacing expensive PV converter area with less expensive optical material. In this chapter, the authors talk about concentrators of solar energy, especially about modules based on holographic films. Holographic solar panels (HSP) last decades appeared in large-scale production and actively used in solar energy. Evaluations of other types of existing concentrators are presented as well.

The Chapter 2 considers information systems that provide analysis of the RES resource base and support decision making. RES resources in the Republic of Kazakhstan are briefly analysed. The methods and systems for evaluation theoretical, technical and economic potential of renewable energy sources are considered. Based on this overview we propose six steps of estimation that should be realized in intellectual GIS. One of the major steps is the identification the factors that affect using of renewable energy sources. These factors can contribute to and impeding the development of green energy. The simple taxonomy of these factors is proposed. The second important step is to aggregate estimations of the factors. As result we propose the aggregation method based on Bayes rule. Compared to other methods this approach allows us to obtain two estimates: probabilities of positive and negative hypotheses. The methods discussed are at the heart of the information system supporting the development of renewable energy sources in the Republic of Kazakhstan.

The Chapter 3 is devoted to consideration the processes of electrical and heat power production with use the products of air conversion of motor diesel fuel and electrochemical generator for agricultural consumer At present, the production of electricity for agricultural consumers remote from the central-

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ized electrical power grid is carried out using diesel-generator technology with a limited service life of engines and extremely low efficiency of the expensive fuel used. In this paper, an innovative technology has been considered for the combined electrical and heat power production using the preliminary conversion of diesel fuel into synthesis gas with its subsequent supply to a high temperature electrochemical generator (ECG). Synthesis gas for the operation of the electrochemical generator was produced by air conversion of motor diesel fuels in a catalytic burner reactor. On the basis of heat balances of the burner, ECG and waste-heat boiler-utilizer, electrical efficiency of the solid oxide fuel cells' (SOFC) battery, chemical efficiency of the burner, the temperature at the SOFC anode, the EMF of the planar cell, a portion of hydrogen oxidized at the SOFC anode, specific consumption of diesel fuel for the production of electrical and heat power were calculated.

Presented in the Chapter 4 research carried out at existing solar power plants and laboratory renewable energy sources, whose purpose was to increase the energy efficiency of photovoltaic installations with parallel and mixed switching of photocells, operating under uneven illumination, parallel voltage arrays of photovoltaic modules due to voltage equalization. Experimental characteristics of photovoltaic installations with the developed "Device for coordinating the array of photoelectric modules" (DCA), realizing a method of selection of electric energy and without its use are given. It is experimentally shown that the use of DCA, allows to increase the electrical power of the array with partial shading up to 2.6 times with partial shading. The results of the research can be used to design new photovoltaic installations and upgrade existing ones.

The Chapter 5 considers the factors that affect the incomplete use of power. The analysis and systematization of accumulating systems on the types of accumulated energy, on the processes occurring during storage, types of devices and types of generated energy is performed. Each of the possible ways of accumulating energy is analyzed in detail. Various variants of conformity of schedules of change of a consumed load within a year and a total resource of solar radiation are considered. The analysis of the parameters of heat-accumulating materials and their classification depending on the material class, the way of heat accumulation and return, on the cyclicity of work, etc. are provided. It is shown that the level of temperature, the scale of the storage unit and the necessary duration of heat storage determine the requirements for the construction of batteries and the choice of heat-storage substances. The prospects of research on the search for new ways of accumulating energy and technical means for their implementation are considered.

The Chapter 6 focuses on different aspects and challenges of power supply for remote energy consumers in the Russian Arctic. Authors discuss the potential use of renewable energy, some specified technological features and risks related to the broader deployment of decentralized renewable energy systems in the Arctic region. Even though there is limited experience of renewable energy systems installation in the Russian Arctic and greater technological challenges, the authors see it as a potential opportunity to contribute to innovative and sustainable development of the region. The authors underline the potential synergistic effect of broader deployment of renewable energy systems in the Russian Arctic. The key argument is that sustainable and efficient energy system will open new development opportunities and stimulate future socioeconomic development of the region through the use of local and renewable energy resources, implementation of new power generation modes and technologies.

In the Chapter 7 renewable energy sources development in rural areas of African countries is considering. The prospects of increasing access to electricity for the population of rural areas of Africa are considered. The main international funds and organizations aimed at sustainable energy development in Africa are described. An analysis of the state and possible options for using renewable energy sources

for this purpose in decentralized energy supply through the creation of mini-grids or stand-alone systems is given. The risks by developing renewable energy.

The object of research in the Chapter 8 is the solar power plant as the source of additional economically expedient power supply of the electrical energy consumer. The purpose of this research is to analyze the options for the layout of solar power plant, taking into account the solar energy potential of the district, the design features of the proposed location, the load curve of the consumer and the cost of the generated electrical energy. The chapter presents the results of calculation and selection of the parameters of solar power plant elements on the roof of the consumer's production building. The chapter presents the results of research of the dependence of the cost of the electricity generated by the solar power plant on the number of installed panels, which in order to increase the realized solar energy potential of the district also allows adding photoelectric modules and accumulating devices in the layout of the operating station at tariff growth. The chapter presents the results of researching these areas, that are conducted by the authors and which are completely original.

In the Chapter 9 the activity of farm enterprises which is directly connected with the efficient use of resources such as electrical energy and water is considering. Taking such conditions as factors of economic expediency and ecological safety into account, it is more reasonable to use wind stations in order to provide consumers with energy and water. The use of conventional wind and electrical stations is an easy and reliable solution. However, annual wind velocity on most settled territories does not exceed 6 m/s or even 4 m/s. It makes the efficient use of wind electrical stations more complicated. One of the solutions can probably be the use of wind and electrical stations on the basis of slow speed non-transmission arc-shaped-stator inductor-type generators with an integrated radial and ring-shaped rotor. Another efficient solution to provide areas with water and electrical energy is to use a combined wind station with a crank-and-rod mechanism and the rod of the driving mechanism of the back-and-forth motion of the core of a magnetic and electrical linear generator and the piston of a plunger pump.

The purpose of the Chapter 10 is to compare the design and operational parameters of energy efficiency (power generation, capacity utilization factor) of a wind power plant (WPP) in order to improve the accuracy of the design parameters estimation at the preliminary design stage. Recommendations have been given for accounting different factors influencing on energy efficiency and economic indicators of a WPP. In this article, the research carried out on the example of existing wind-diesel complexes (WDC) in the settlement of Ust-Kamchatsk (Kamchatka Krai), Novikovo (Sakhalin Oblast) and projected WDC on Popova Island (Vladivostok city district).

Considered in the Chapter 11 doubly Fed Induction Generator (DFIG) is widely spread technology in modern wind turbines (WT), due to its capability to operate with variable speed, partial scale power converter and ability to control active and reactive power independently. The main drawback of DFIG is its complicated protection systems. In the chapter, several strategies for DFIG protection are reviewed and provided a conclusion about their advantages. Penetration of renewable energy sources (in particular wind power) have a huge impact on power systems, thus, wind turbines should be considered as conventional generation units in terms of frequency and voltage regulation. Modern grid codes require WT stay connected during grid fault and be capable to provide appropriate grid support. Therefore, it is important to implement DFIG protection system, which could meet grid code requirements.

The Chapter 12 describes the advanced technologies of energy and water saving on the Uzbekistan largest pumping stations of Karshi Main Canal. The unique Karshi pumping stations stage consumes more than 4% of the total electricity generated in Uzbekistan. Such a significant consumption of electricity by irrigative pumping stations, gives the problem of energy conservation to them a status of special

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importance and relevance. Advanced technologies of energy saving, and non-cavitation work are scientifically substantiated and developed. The results of carried out field tests are described. The scientific results of the research are recommended to allow efficient use of water and energy resources and to ensure reliable operation of the power equipment of pumping stations in the rural branches of economy.

In the Chapter 13 relevant of improving power quality of agricultural consumers by adjusting the cost of electricity is considered. The chapter lists the reasons for the output of power quality indicators beyond the standard values. There is the assessment of the quality of electricity in the Orel region. Distribution functions for distortion of power quality indicators are constructed. The relevance of the adjustment of the cost of electricity depending on its quality is justified. The mathematical model for determining the cost of consumed electric energy depending on its quality is developed in paper. The paper gives the method allowing to adjust the cost of consumed electric energy depending on its quality and source of distortion. In the paper there is the mechanism of carrying out calculations for the consumed and transferred electric power considering change of electric power cost depending on its quality. The feasibility study of the proposed methods and means of improving power quality is realized.

In the Chapter 14 noncontact electric power supply with the use of cable line is considered. It is an innovative trend in the development of electric transport. Work to develop such systems is carried out in the USA, South Korea, Germany, Israel, the Russian Federation. The VIESH researchers have developed and patented experimental models of a car and a tramway of the future without accumulators, which receive energy from external energy system through air gap from a single wire cable laid under the surface of road pavement. Noncontact systems for electric power supply to transport are developed at VIESH on the basis of resonant methods of electric power supply through a single-wire cable. This is a basic difference of the technology under consideration from similar ones. This technology makes it possible to realize at the new technological level the need for electric roads with minimal costs. Given that all the world's automakers are working on the production of an electric vehicle for mass production, the need for creating a motorway in the city and on inter-urban autobahns is even more topical.

The Chapter 15 analyzes the power supply restoration time. The analysis shows that this time consists of the time for obtaining information about failure, the time of information recognition about failure, the damage repair time and the time of connection and disconnection harmonization. Each of them, in turn, is also considered in more detail that allows identifying reserves to reduce the power supply outage time. The paper proposes reducing the power supply restoration time by going to the monitoring system combination of both operating modes and technical condition of power networks. Based on the study results there are methods allowing to reduce the power supply outage time of rural consumers by means of automating rural electrical networks and improving the operating mode monitoring of power supply systems. The paper also suggests a set of devices that allows to implement the proposed methods.

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