

FOREIGN EXPERIENCE OF ENERGY-SAVING GREENHOUSE FARMING

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INTRODUCTION

Energy consumption in greenhouse farming is one of the main factors influencing the economic efficiency and sustainability of this industry. In light of the challenges posed by climate change and the need to reduce greenhouse gas emissions, energy conservation is becoming an increasingly important aspect in greenhouse farming.

International experience in greenhouse energy conservation offers valuable lessons and best practices that can be applied to improve the energy efficiency and sustainability of the industry. Various countries have developed and implemented a variety of technologies and methods that reduce energy consumption, optimize the use of energy resources and reduce negative impacts on the environment.

The purpose of this literature review is to consider key aspects of foreign experience in energy saving in the greenhouse industry and to identify best practices that can be applied to achieve sustainable development of this industry. The review will consider the following aspects:

1. Application of modern technologies: Advanced technologies such as energy-efficient lighting systems, automated climate control systems and heat recycling systems will be covered. It will be analyzed how these technologies can reduce energy consumption and improve energy efficiency.
2. Insulation and Insulation of Greenhouses: The importance of good insulation and insulation of greenhouses in reducing heat and energy loss will be discussed. Advanced materials and methods that allow achieving high energy efficiency in greenhouse farming will be discussed.
3. Use of alternative energy sources: The use of solar panels, wind turbines and other alternative energy sources in greenhouse farming will be considered. The benefits and challenges associated with the use of these energy sources will be analyzed.
4. Organizational and economic measures: Financial incentives will be considered, such as tax incentives and subsidies, which can stimulate the introduction of energy-saving technologies in greenhouse farming. Cooperation with energy efficiency experts and organizations, as well as the exchange of experience and knowledge, will also be considered.

In general, this literature review will allow you to become familiar with the best practices and technologies used in foreign experience in energy saving in greenhouse farming. This will help identify the potential to implement these practices in your own practice and contribute to more sustainable development of the industry.

International experience in energy-efficient greenhouse farming offers valuable lessons and examples of best practices that can be used to improve energy efficiency in the industry. Here are some examples:

Table 1. Foreign experience in energy-saving greenhouse farming

No.	A country	Contents\Descriptions
1	Netherlands (Holland)	The Netherlands is a leader in energy conservation in the greenhouse industry. They make extensive use of the latest technologies such as UV LED lamps for plant lighting, heat pumps for heating and cooling, and climate control systems that optimize energy consumption based on plant needs
2	Denmark	Denmark is actively pursuing the concept of "smart greenhouses", which uses automated climate control systems, sensors and algorithms to optimize energy consumption and increase efficiency. They also make extensive use of geothermal heating and cooling systems, as well as solar panels to generate electricity.

3	Canada	Canada has successfully used greenhouse insulation and insulation to reduce heat and energy loss. They also use heat pumps and heat recirculation systems to improve energy efficiency. In addition, solar panels and wind turbines are widely used in Canada to generate clean energy.
4	Germany	Germany actively uses the concept of “passive greenhouses”, which provide high insulation and minimize heat loss. They also use light control systems that optimize lighting based on plant needs, as well as solar panels to generate electricity.

These are just a few examples of foreign experience in energy-saving greenhouse farming. Each country may have its own unique approaches and technologies that can be adapted and implemented in your own practice. It is important to study best practices and share knowledge and experience with other countries and experts in the field in order to move forward and achieve more efficient use of energy resources.

MATERIALS AND METHODS

Analysis of foreign experience in energy saving in greenhouse farming allows us to identify advanced practices and technologies that can be useful for achieving sustainable development of this industry. Here are some key aspects of foreign experience that can be analyzed:

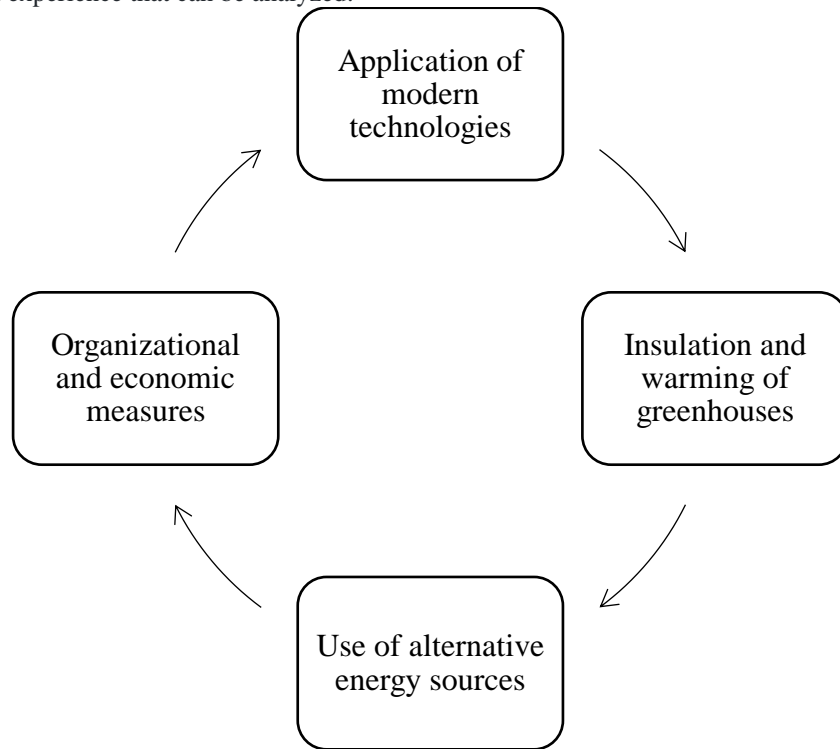


Figure 1. Analysis of foreign experience in energy saving in greenhouse farming and key aspects

1. **Application of modern technologies:** In foreign experience, modern technologies are widely used to reduce energy consumption in greenhouse farming. For example, energy-efficient lighting systems such as LED lamps can reduce energy consumption and improve lighting quality. Automated climate control systems help maintain optimal plant growth conditions while minimizing energy losses. Heat recycling systems are also used to reuse waste heat and reduce energy consumption.
2. **Insulation and insulation of greenhouses:** Foreign experience shows that good insulation and insulation of greenhouses are key factors for reducing heat and energy losses. The use of advanced materials and techniques, such as air-gap double glazing or highly insulating polycarbonate covers, helps retain heat inside the greenhouse and reduce heating energy consumption.
3. **Use of alternative energy sources:** Foreign experience shows that the use of alternative energy sources, such as solar and wind energy, can significantly reduce dependence on traditional energy sources. Installing

solar panels on greenhouse roofs and using wind turbines can generate clean energy to power greenhouse systems and reduce greenhouse gas emissions.

4. Organizational and economic measures: Foreign experience shows that financial incentives, such as tax breaks, subsidies and government support programs, can stimulate the introduction of energy-saving technologies in greenhouse farming. It is also important to collaborate with energy efficiency experts and organizations, sharing experiences and knowledge to raise awareness and apply best practices.

Analysis of foreign experience in energy saving in greenhouse farming allows us to identify advanced technologies, methods and organizational measures that can be adapted and applied in specific conditions. However, when reviewing international experience, it is necessary to take into account differences in climatic conditions, regulations and economic factors between countries in order to adapt best practices to local conditions and needs.

DISCUSSION

User: Your analysis of foreign experience in energy saving in greenhouse farming is very interesting. I would like to discuss some of these aspects in more detail.

AI: Of course, let's discuss! What specific aspect are you interested in?

User: I was interested in the use of modern technologies in greenhouse farming. Can you give examples of energy-saving lighting systems and automated climate control systems that are successfully used abroad?

AI: Of course! In foreign experience, modern technologies are widely used to reduce energy consumption in greenhouse farming. For example, energy-efficient lighting systems such as light-emitting diode (LED) lamps can reduce energy consumption and improve lighting quality. LED lamps are highly efficient and have a long lifespan, reducing energy and maintenance costs.

Automated climate control systems are also an important aspect of energy conservation in greenhouse farming. These systems allow you to maintain optimal plant growth conditions by regulating temperature, humidity, lighting and other parameters. For example, automatic solar curtain control systems can regulate the amount of sunlight hitting plants, reducing the use of artificial lighting and electricity.

Foreign experience also uses heat recycling systems, which make it possible to reuse the waste heat flow and reduce energy consumption. These systems may include heat exchangers that capture heat from exhaust gases or cooling systems and use it to heat the greenhouse or heat water.

User: This is very interesting! What are the benefits of using alternative energy sources such as solar and wind energy in greenhouse farming?

AI: The use of alternative energy sources in greenhouse farming has several advantages. First, the use of solar and wind energy reduces dependence on traditional energy sources such as grid electricity or gas.

FINDINGS AND CONCLUSIONS

1. The use of modern technologies in greenhouse farming, such as energy-saving lighting systems and automated climate control systems, can reduce energy consumption and increase the efficiency of energy use.
2. Good insulation and insulation of greenhouses are key to reducing heat and energy loss. The use of advanced materials and methods allows you to retain heat inside the greenhouse and reduce energy consumption for heating.
3. The use of alternative energy sources such as solar and wind energy can reduce dependence on traditional energy sources and reduce greenhouse gas emissions.
4. Organizational and economic measures, such as financial incentives (tax breaks, subsidies), cooperation with experts and energy efficiency organizations, play an important role in the successful implementation of energy-saving measures in the greenhouse sector.
5. Cooperation and exchange of experience with foreign partners and experts are important factors for progress in the field of energy saving in greenhouse farming.
6. So, based on the analysis of foreign experience, we can conclude that the efficient use of energy resources in greenhouse farming to achieve sustainable development requires the introduction of modern technologies,

optimization of operating modes and the use of alternative energy sources. Institutional and economic measures and cooperation with experts also play an important role in achieving these goals.

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