

## ENERGY AND RESOURCE CONSERVATION

Method Guide to Doing Homework  
Assignments for students of major  
6.050604 "Mechanical power engineering"  
speciality 7.07010301  
"Maintenance and repair of aircrafts  
and aircraft engines"

Kyiv 2014



Compilers: *A. P. Voznyuk, P. I. Grekov, K. I. Kapitanchuk,  
E. P. Yasinitskyi, I. E. Yasinitska*

The English Language Adviser *A. Y. Kravchuk*

Reviewer *O. A. Shevchenko*

*Approved by the Methodical and Editorial Board of the National  
Aviation University (Minutes № 2/13 of 14.03.2013).*

Містять рекомендації щодо вивчення дисципліни, питання для само-  
контролю, список літератури та завдання для виконання домашніх робіт.

Для студентів напряму підготовки 6.050604 «Енергомашинно-  
будування» спеціальності 7.07010301 «Технічне обслуговування та  
ремонт повітряних суден і авіадвигунів».

Е 627

**Energy and Resource Conservation** : Method Guide to Doing  
Homework Assignments / Compiled by *A. P. Voznyuk, P. I. Grekov,  
K. I. Kapitanchuk, E. P. Yasinitsyi, I. E. Yasinitska.* – K. : NAU,  
2014. – 36 p.

The method guide contains directions on studying the course,  
recommended literature and self-check quizzes and homework assignments.  
For students of major 6.050604 "Mechanical power engineering" speciality  
7.07010301 "Maintenance and repair of aircrafts and aircraft engines".

## GENERAL METHODIC GUIDE

The problem of energy and supply saving is closely connected with the problems of power engineering, ecology, equipment upgrading and total restructuring of the country's economy.

Energy and supply saving is highlighted as one of the most important tasks in the current Ukrainian state policy.

The subject "Energy and Supply Saving in Industry Heat Energetics" is a special discipline in the system of theoretical and practical training of specialists. All specialists who deal with problems of using fuel and energy resources must know the base of this subject.

Theoretical knowledge is important to understanding the structure and present situation of the fuel and energy complex of Ukraine, the main clauses of Ukrainian Law on Energy Saving as well as for finding ways and means to minimize energy and supplies consumption, to streamline power efficiency of production, to introduce modern energy saving technologies in different fields of the economy.

The objective of the discipline is to give future specialists the bases of energy and supply saving, to cultivate frugal approach to fuel and energy and to popularize economical, environmental and social advantages of energy saving in accordance with the current legislation of Ukraine.

The tasks of mastering the discipline are the following:

- to give students theoretical knowledge of energy saving and practical skills on using modern energy saving technologies in different branches of the national economy;
- to get acquaintance with the Ukrainian laws concerning energy and supply saving;
- to acquaint students with the ways of compiling the energy enterprise certificate;
- to give examples of technical solutions aimed at boosting the energy saving level at plants of different branches of the national economy.

The course contains two modules.

After completing module №1 "Energy and supply saving in structure of fuel and energy complex of Ukraine", the students must KNOW:



- the current situation in the fuel and energy complex of Ukraine and ways of improving the efficiency of using fuel and energy supplies usage;

- main clauses of the Law of Ukraine on Energy Saving;
- the structure of the standard energy certificate of an enterprise that utilizes energy supplies.

Upon the module completion, the students must BE ABLE to:

- make an energy usage chart;
- carry out metering and record-keeping of energy consumption;

Having mastered the material of module №2 “New technologies of energy and Supply Saving in Heat Energetics”, the students must KNOW:

- ways of improving the efficiency of energy use at enterprises;
- main concepts and notions, trends and principles of using non-traditional and renewable sources of energy.

Upon the module completion, the students must BE ABLE to:

- estimate possible energy saving prospects at enterprises.

The discipline “Energy and Resource Conservation” is studied at the semester and covers 135 hours. 67 hours are allocated for independent study using the recommended literature and periodic publications.

The lectures (34 hours) give information about the Ukrainian legislation concerning energy saving, technical support of energy and supply saving at enterprises, use of non-traditional and renewable sources of energy.

Practical course (34 hours) is aimed at deep understanding of the main concepts of the discipline, giving students practical skills on expert estimation of energy consumption at enterprises. The program presupposes the fulfillment of home assignments and an exam.

## LITERATURE

### Main

1. *Паливно-енергетичний комплекс України на порозі третього тисячоліття / за заг. ред. А. К. Шидловського, М. П. Ковалка.* – К. : Українські енциклопедичні знання (УЕЗ), 2001.
2. *Матеріали Міжнародної конференції «Енергетична безпека Європи. Погляд у XXI століття».* – К. : УЕЗ, 2001.
3. *Паливно-енергетичний комплекс України у цифрах та фактах / за ред. М. П. Ковалка.* – К. : УЕЗ, 2000.
4. *Діак І. В. Газова промисловість України на зламі століть / І. В. Діак, З. П. Осінчук.* – Івано-Франківськ : Лілея-НВ, 2000.
5. *Ковалко М. П. Енергозбереження – досвід, проблеми, перспективи / М. П. Ковалко.* – К. : Наукове видання Національної академії України. Держкоменергозбереження України, 1997.
6. *Енергозбереження – пріоритетний напрямок державної політики України / М. П. Ковалко, С. П. Денисюк; відп. ред. А. К. Шидловський.* – К. : УЕЗ, 1998.

### Additional

7. *Мхитарян Н. М. Энергосберегающие технологии в жилищном и гражданском строительстве / Н. М. Мхитарян.* – К. : Наук. думка, 2000.
8. *Мхитарян Н. М. Энергетика нетрадиционных и возобновляемых источников. Опыт и перспективы / Н. М. Мхитарян.* – К. : Наук. думка, 1999.
9. *Украина : энергосбережение в зданиях / Энергетический Центр Европейского Союза в Киеве (Программа TACIS), 1994.*
10. *Березовик М. М. Энергозбереження – гарантія тепла в наших оселях / М. М. Березовик, С. П. Денисюк, В. М. Кодрянський, А. П. Кухта, Т. В. Трипун.* – К. : УЕЗ, 2001.
11. *Довідник працівника газотранспортного підприємства / В. В. Рудник, В. М. Коломєєв [та ін.].* – К. : Росток, 2001. – 1091 с.
12. *Фокин В. М. Основы энергосбережения и энергоаудита / В. М. Фокин.* – М. : Машиностроение, 2006. – 248 с.



## GUIDE ON STUDYING THE COURSE

### Module 1

#### ENERGY AND SUPPLY SAVING IN FUEL AND ENERGY SYSTEM OF UKRAINE

##### 1.1. Introduction: Energy Saving as a Factor of Environmental and Economical Security of the Country

Energy saving as a factor of environmental security of a country. Impact of the power industry on the environment and public health. Greenhouse gas effect. Acid rains. Climate changes. Energy saving as a factor of energy security of a Country.

Literature: [1-4]; [6-10].

##### Method Guide

When studying the introduction part of the discipline it is necessary first of all to realize the vital importance of energy saving in all branches of the Ukrainian economy, the necessity to change the situation in the power industry which is only possible through respective changes in the social, economic and spiritual spheres of the modern society.

Considering the issues of environmental security of the country, it is important to realize the harmful effect of power industry on the modern environment; has it become planetary concern problems: greenhouse gas effect, ozone holes, acid rains and others.

Such natural phenomena are the results of careless activities of the humankind. They threaten the wildlife, ruin historical and cultural monuments.

Energy saving is one of the crucial directions of ensuring energy security in the country which means confidence in having enough energy of respective quality in proper economic conditions.

So, the most important way to increase the level of energy security is improvement of the efficiency of using fuel and energy and directing the economy to energy efficient ways of development.

## Quiz

1. What does the 'Environmental Security of a Country' mean?
2. Give examples of climate changes in the world and in Ukraine.
3. Give examples of consequences of the greenhouse gas effect.
4. Give examples of impact by nitric oxide and sulfuric anhydride impact on the environment.
5. What is the difference between the energy security of a country exporting energy and that of a country that imports it?
6. Give examples of the energy share increase in the prime cost structure of manufactured goods.
7. Give examples of the environmental share increase in the energy security of a country.

##### 1.2. Energy and Fuel Complex of Ukraine. Energy and Fuel Supplies

The mining complex of Ukraine. The oil and gas complex of Ukraine. A united electric power system. Heat-and-power engineering. Hydro-power engineering. Nuclear-power engineering.

Literature: [2-4]; [6-10].

##### Method Guide

When studying the topic material, it is necessary to remember that the fuel and energy complex of Ukraine is a complicated inter- industry system of production, transportation, distribution and utilization of fuel and energy.

When considering the mining complex of Ukraine, the main field of black and brown coal, it is necessary to stress problems and possible ways to recover and work out the industry energy development program.

While studying oil and gas complex it is important to know the main components of oil and understand the difference between the structure of natural gas in deposits of gas and gas condensate and associated gases of oil production.

Students should know how to describe main regions of oil fields and the structure of oil/gas production and use, the oil and gas pipeline and transportation system of Ukraine.

Considering hydro- and heat-and-power engineering it is necessary to pay close attention to the uneven distribution of industrial production



across the territory of Ukraine, nearly 100% service life expiration of power complexes and possible turning of the state fuel crisis into a technological crisis.

Nuclear power plants are the main producer of electric power in modern Ukraine (40 to 45%) and together with hydro power plants they control the rise of tariffs.

However, there are problems associated with building new blocks and utilizing old ones.

### Quiz

1. What are the components of the fuel and energy complex of Ukraine?
2. What is the structure of the fuel industry?
3. Name the main strategic goal of the fuel and energy complex of Ukraine.
4. Which supplies are included to the classification of fuel and energy resources?
5. Which kinds of fuel are considered to be natural?
6. Which kinds of energy are natural?
7. Which kinds of fuel are fuel processing products?
8. Which kinds of energy supplies are fuel secondary energy supplies?
9. What process is called coalification?
10. List the formation stages of humus mineral fuels.
11. Enumerate the main black and brown coal basins in Ukraine.
12. Describe the potential of the main black and brown coal basins.
13. Name the main components of oil.
14. Name the main parts of biomass of oil.
15. What is the difference between natural gas in gas fields and that of gas condensate fields?
16. List main oil and gas regions in Ukraine.
17. What is the purpose of drying and desalinization of gas before transporting it by pipelines?
18. Outline the potential of the main oil and gas basins in Ukraine.
19. Enumerate Ukrainian refineries.
20. What is the difference between an oil pipeline and an oil product pipeline?
21. Describe the gas transport system of Ukraine.
22. Describe heat-and-power engineering of Ukraine.
23. Describe hydro-power engineering of Ukraine.
24. Describe nuclear-power engineering of Ukraine.
25. How many functional nuclear power plants are there in Ukraine?

### 1.3. Law of Ukraine on Energy Saving. Government Programs of Energy Saving

The Law of Ukraine on Energy Saving. The Complex Government Program on Energy Saving in Ukraine and Additional Measures and Activities of Implementation of the Complex program. The Program of state support of development non-traditional and renewable sources of energy and small-scale hydro- and heat-and-power engineering in Ukraine. A set of measures aimed at reduction of natural gas consumption in Ukraine.

**Literature:** [1-2]; [4-6].

### Method Guide

When studying the Law of Ukraine on Energy Saving, it is necessary to concentrate on legal, economy, social and environmental aspects of energy saving for all enterprises and institutions in Ukraine as well as all dwellers.

The law introduces the following concepts: energy saving, energy policy, fuel and energy reserves, frugal use of them, energy saving technologies, standards of fuel and energy consumption, secondary energy sources, non-conventional and renewable energy sources.

While studying the first part of the law it is necessary to understand the goals and purposes of the law on energy saving and memorize main principles of the state energy saving policy.

Separate issues developed are objects and subjects of legal regulation of relationship, education and study, energy saving management, government programs and scientific research.

When studying the second part of the law, it is necessary to memorize economic mechanisms of budget funding and energy saving stimulation, use of non-budget funds and economic sanctions imposed for waste of fuel and energy reserves.

The third and fourth sections of the law are dedicated to standards, norms and rules of fuel and energy consumption, state expert examination of energy saving. Students must understand the necessity of fulfillment of orders and conclusions of this examination.

Energy saving control and responsibility of officials for breaking the law are defined in the fifth section. The sixth section deals with the international legal position of Ukraine in the energy saving sphere.



When studying “Complex State Program of Energy Saving in Ukraine”, “Program of State Support of Development of Non-conventional and Renewable Sources of Energy and Micro and Mini hydro- and heat-power Engineering”, “Set of Measures Aimed at Reduction of Natural Gas Consumption in Ukraine”, it is necessary to understand the goal and main tasks which must be solved with the help of these programs and know the stages of their implementation.

### Quiz

1. Which government institutions are responsible for energy saving management?
2. Define the notions of Energy Saving Law: energy saving, energy policy, fuel and energy reserves, frugal use of fuel and energy supplies, fuel saving and energy supplies, an energy efficiency technology, norm of fuel and energy consumption, secondary energy sources, non-conventional and renewable energy sources.
3. Define the purpose of the Ukrainian law concerning energy saving.
4. List the main principles of the government policy in the energy saving sphere.
5. What are sources of funding activities related to efficient use and saving of fuel and energy?
6. How does the Law on Energy Saving stimulate energy saving?
7. What economic sanctions are imposed on legal person and individuals according to the Law of Energy Saving?
8. What are the goals of standardization and regulation in the energy saving sphere?
9. Name the purpose, main tasks and implementation stages of the Complex State Program of Energy Saving in Ukraine.
10. Name the purpose, main tasks and implementation stages of the Program of State Support of Development Non-Traditional and Renewable Sources of Energy and Micro- and Mini Hydro- and Heat-and-Power Engineering in Ukraine.
11. Name the purpose, main tasks and implementation stages of the Set of Measures Aimed at Reduction of Natural Gas Consumption in Ukraine.

#### 1.4. Energy Saving in Different Branches of National Economy of Ukraine

A notion of energy saving policy of Ukraine. The main trends of energy saving in different branches of national economy of Ukraine: in

the power supply systems, in residential sector, in the industry, construction, transportation, agriculture.

Literature: [1]; [2]; [4]; [6–12].

### Method Guide

When studying the material it is necessary to comprehend that energy saving policy is:

- a long-term set of measures aimed at increasing the efficiency of energy supplies application in the economy of the country achieved by reducing end-user energy consumption;
- an increase in the efficient energy use factor by improving the production, processing, distribution and utilization of fuel and energy supplies;
- replacement of expensive and limited energy sources with cheaper and unlimited ones;
- restructure of economic complexes taking into account environmental aspects.

The energy saving policy presupposes realization of a set of measures (which you must know), which will lead Ukraine to the world level in efficient use of fuel and energy supplies. It is important to distinguish saving of fuel and energy supplies resulting from ‘natural’ changes, technical progress in the economy, from saving resulting from aggressive actions, for example after investments and direct economic stimulation. This implies direct, indirect and structural saving of fuel and energy supplies.

The energy saving policy is based on implementation of the complex state program of energy saving. It is necessary to know the priority directions of energy saving policy in different fields of the national economy, be able to determine specific measures for energy saving in power supply systems (electricity, heating, gas) in resident energy services, in ferrous and non-ferrous metallurgy, in oil and gas industry, chemical industry, machine industry, metal-working manufacturing, food industry, wood and timber industry, construction, transport and agriculture.

### Quiz

1. List the measures envisaged by the energy saving policy, which will lead Ukraine to the world level of efficient utilization of fuel and energy, supplies.



2. What is direct and indirect saving of fuel and energy supplies?
3. What is structural saving of fuel and energy supplies?
4. What are theoretical, technical and economic potentials of energy saving?
5. List the priority directions of energy saving in electric power supply systems.
6. List the priority directions of energy saving in heating supply systems.
7. List the priority directions of energy saving in gas supply systems.
8. List the priority directions of energy saving in housing and communal services.
9. List the priority directions of energy saving in ferrous metallurgy.
10. List the priority directions of energy saving in non-ferrous metallurgy.
11. List the priority directions of energy saving in the oil and gas industry.
12. List the priority directions of energy saving in the chemical industry.
13. List the priority directions of energy saving in mechanical engineering.
14. List the priority directions of energy saving in the wood and timber industry.
15. List the priority directions of energy saving in construction.
16. List the priority directions of energy saving in transport.

### 1.5. Comparative Analysis of Centralized and Decentralized Energy Supply

A comparative analysis of centralized and decentralized energy supply. The factors which influence introduction of decentralized energy supply. Co-generation. The Vodoley technology.

**Literature:** [1]; [2]; [4]; [10].

#### Method Guide

When you analyze heat supply of Ukraine, commercial and household premises in the countries of Central and Western Europe, pay attention to service wear of many heat and power plants and danger that they pose to the environment.

Decentralized production of electric power and heat increases the total efficiency of the production due to a number of factors, which you must know.

In modern technologies of decentralized heat and power plant construction with the capacity of 10 MW and less, internal combustion engines, steam and gas turbines are used. It is necessary to know the advantages and drawbacks of each type of cogeneration and be able to explain the main modes of the gas-turbine cycle (simple, regenerative, and with intermediate cooling of the operating cycle).

When studying the new technology of fuel elements, students must comprehend their main benefits, operational ranges of temperature during methane conversion and the electrochemical process of uniting hydrogen with oxygen at electricity generation.

When choosing the most efficient technology for a decentralized heat and power plant, the following factor should be considered:

– the peak electricity load, the ratio of heat to electricity, the cost of natural gas, a maintenance possibility. Specialists must know which technology should be chosen and when.

The following regulating factor should be known when studying the system of development stimulation of decentralized energy supply: the price policy, the energy market, rights to sell electricity and heat energy. Heat that is used in absorption and refrigerator plants has great prospects for cogeneration both in industry and household.

It is necessary to understand the fundamentals of operation, sources of energy and required operation conditions.

The steam and gas technology of Vodoley is based on the principle of steam regeneration into steam condensate in a contact gas cooler condenser.

It is necessary to know the prospects of this technology and unsolved problems for their industrial application in the future.

#### Quiz

1. Ways to reduce energy losses in the production of electricity and thermal energy.
2. Ways to reduce energy losses at its transportation.
3. Reduction of electricity spending in industry.
4. Reduction of electricity and heat spending in the housing and utilities sector.
5. What are the main causes of energy loss in power.
6. What are the priorities for energy efficiency at the power plants.
7. Describe known ways of thermal energy generation.
8. Features of thermal energy in industrial enterprises.
9. Features of thermal energy in educational, medical institutions and cultural institutions.
10. Ways to reduce heat losses in the housing and utilities sector.
11. What are the main causes of heat losses during transportation.
12. List the main types of fluids indicate its advantages and disadvantages.
13. Priority areas of energy saving in housing and communal sector



14. What modern materials used for heat transportation.
15. What modern insulating materials used.
16. What are the main ways of energy losses in gas supply of housing and communal services.
17. What are the main ways of energy losses in gas supply of industrial facilities in different directions.
18. Explain the impact of maintenance of process equipment for energy losses in industry.
19. Explain the impact of the technical state of gas transmission system losses energy resources.
20. Priorities in energy supply systems.
21. Which energy supply system is the most commonly used in the countries of Central and Western Europe?
22. Characterize the current situation in the centralized energy supply in Ukraine.
23. List the advantages of the decentralized energy supply system.

### 1.6. Centralized and decentralized energy supply

The main equipment used in centralized and decentralized production of heat and electricity. Individual heating systems.

Literature: [7]; [8]; [10].

#### Method Guide

The main form of energy supply in many countries has been and remains a long-term centralized system. Combining energy generating units, transforming units, switchgears and energy consumers, they are characterized by common principles of formation and mode of all links, interdependent of production process, distribution and energy usage.

Currently, the district heating system requires systematic complex technical and organizational measures to be taken. Among them: pipelines replacement using effective insulation materials, thermal reconstruction of points with the installation of these automated heat, exercise CHP teamwork and boiler to the general thermal network, the construction of highly efficient combined-cycle CHP cycle conversion of district boilers mini-CHP, the introduction of advanced solid fuel combustion technology, application of computer technology to manage systems and others.

Standalone systems are equipped with modern boilers (efficiency is equal to 92...95 %) are more economical than centralized systems.

Modern self-contained automated boiler serviced by staff, allow their installation and commissioning in the short term. In addition, the placement of these boilers does not require special drainage areas.

According to foreign experts autonomous boiler for large cities should not be larger competitors CHP and district boiler, but to be an effective complement to their appropriate share of 10...15 % of the potential market for thermal energy. But at the same time, it is necessary to develop technologies using alternative sources of energy (due to shortage and rising gas), which should lead to greater use of decentralized energy sources with a high level of economic efficiency and environmental acceptability.

International experience has shown that the costs of establishing local systems pay for themselves within a year. By studying this subject should note that in some cases in Ukraine autonomous energy supply system should be used for individual buildings during their construction or upgrading.

#### Quiz

1. What is the basic equipment used in centralized production of heat and electricity?
2. What equipment is used for decentralized production of heat and electricity?
3. What are the main disadvantages of decentralized heat production?
4. What fuel is used in individual heating systems?
5. In some cases it is expedient to use decentralized energy supply system?
6. Impact on the environment of decentralized heating systems.
7. Impact on the environment of centralized power.
8. What heating system should be used in decentralized heating systems?



## Module 2

### NEW TECHNOLOGIES OF ENERGY AND SUPPLY SAVING IN INDUSTRIAL ENERGY

#### 2.1. Energy efficiency in electric and thermal power, heating and gas. Cogeneration

The main directions of energy efficiency in public areas of Ukraine, associated with the production, transportation and consumption of electricity and thermal energy. Cogeneration.

**Literature:** [7]; [8]; [10].

#### Method Guide

By studying this subject need to pay attention to the fact that in such economic sectors as electricity and thermal power, oil and gas industry, the housing sector an outdated energy-intensive equipment, causing increasing energy consumption. As a comprehensive state energy conservation program outlined priorities for energy efficiency in various sectors of the economy.

#### Quiz

1. Ways to reduce energy losses in the production of electricity and thermal energy.
2. Ways to reduce energy losses at its transportation.
3. Reduction of electricity in industry.
4. Reduction of electricity and heat in the housing and utilities sector.
5. What are the main causes of energy loss in power?
6. What are the priorities for energy efficiency at the power plants?
7. What are the ways of thermal energy production?
8. Features of thermal energy in industrial enterprises.
9. Features of thermal energy in educational and medical institutions and cultural institutions.
10. Ways to reduce heat losses in the housing and utilities sector.
11. What are the main causes of heat losses during transportation?
12. List the main types of fluids indicate its advantages and disadvantages.
13. Priority areas of energy saving in housing and communal sector.
14. What modern materials used to deliver heat?
15. What modern insulating materials.
16. What are the main ways of energy losses in gas supply of housing and communal services?

17. What are the main ways of energy losses in gas supply of industrial facilities in different directions?
18. Explain the impact of maintenance of process equipment for energy losses in industry.
19. Explain the impact of the technical state of gas transmission system losses energy resources.
20. Priorities in energy supply systems.
21. What fuel is the most commonly used for cogeneration plants and municipal decentralized power plants and why?
22. Define the term cogeneration.
23. List the advantages of cogeneration.
24. Draw the scheme of a simple gas-turbine cycle.
25. Draw the scheme of a regenerative cycle with interim heating.
26. Draw the scheme of a gas-turbine cycle with interim cooling of the working medium.
27. Give definition to methane conversion.
28. Which electrochemical process is used in fuel elements?
29. List the main benefits of fuel elements.
30. What types of fuel elements do you know?
31. List the main markets of cogeneration in industry.
32. What is the source of energy used in compressor refrigerating plants?
33. What is the source of energy used in absorption refrigerating plants?
34. What type of refrigerating plant would you recommend for a country with a hot climate?
35. What are the benefits of the Vodoley technology?
36. What are the unsolved problems of the Vodoley technology?

#### 2.2. Heat Utilization. Turboexpander Plants

Heat utilization. Utilization of gas excessive pressure in pipelines for producing electricity and conversion of turboexpander cold into electricity.

**Literature:** [1]; [2]; [4-10].

#### Method Guide

An environmentally friendly heat utilization plant for secondary energy resources is used for reduction of nitric oxide emission and utilization of the heat of natural gas combustion products that are released into the environment with the purpose of heating premises and water for industrial use.



A heat utilization plant is a combined heat exchanger which consists of a heat utilizer and heater. Together they form a circulation loop.

When studying utilization of natural gas excess pressure energy, which is generated during forced throttling while transporting gas through gas mains, it is advisable to concentrate on the operating principle, purposes, advantages and disadvantages of turboexpander heat utilization plants. They are used at gas distribution stations and other energy sites. Their capacity is used to run electric generators, sometimes compressors and pumps, etc.

### Quiz

1. What is a heat utilization plant?
2. What are economic and environmental benefits of using heat utilization at power-consuming enterprises?
3. What are economic and environmental benefits of using heat utilization at ventilation networks of buildings of different kinds?
4. What are economic and environmental benefits of using heat utilization of water which is dumped into sewerage?
5. What are economic and environmental benefits of using heat utilization at refrigerating plants and cold rooms?
6. Explain the physical nature of excessive energy pressure during forced throttling of natural gas while transporting it.
7. What are the benefits of turboexpander heat utilization plants?
8. Why is it necessary to heat gas before it is fed into a turboexpander heat utilization plant?
9. What may happen if gas is not heated before being fed into a turboexpander heat utilization plant?
10. What are the unsolved problems which hinder widespread use of turboexpander heat utilization plants?

### 2.3. Energy Saving in Household and Communal Sphere. Thermal Effectiveness of Buildings

Energy saving in the household and communal sphere. Optimization of thermal effectiveness of buildings according to the climate conditions. Long-term directions of improving thermal effectiveness of dwelling houses. Improving of thermal effectiveness through practical choice of fencing structures of buildings. New energy saving heat insulation materials. Thermoshield.

Literature: [1]; [2]; [4-10].

### Method Guide

The main heat waste factor and demand of energy for heating is resistance to heat transfer by external structures of buildings that is walls, windows, panels and ceilings.

You must know the norms of heat transfer resistance by external structures of buildings according to the Building Code (construction norms and specifications). It was widely used in the former Soviet Union and it is still used nowadays with many amendments.

Concentrate your attention on the need to increase economically feasible resistance to heat transfer by external filler structures of buildings at the cost of additional investments and implementation of this increase by introduction to the four climatic zones in Ukraine.

Improvement of heat insulation properties of non-transparent filler structures is achieved by using multilayer insulation panels. It is necessary to know the general requirements to such materials and their qualities.

When calculating the best thickness of thermal insulation from the economical viewpoint, it is necessary to know that this critical parameter depends on world prices for energy carriers and may change with time.

When studying different means of improving thermal insulation properties of structural components of buildings such as external walls, roof, windows, etc, it is important to realize the expediency of applying each means, know their advantages and shortcomings, be able to analyze the current condition of the existing buildings and recommendations as to their thermal insulation improvement.

### Quiz

1. What is the main factor responsible for heat waste in a building?
2. What are the units used for measuring heat transfer resistance of external filler structures of buildings?
3. What are the norms of heat transfer resistance of external filler structures of buildings made of reinforced concrete in accordance with the Building Code?
4. What are the reasons why heat transfer resistance of external filler structures should be raised?
5. How do you understand the notion of economically feasible resistance?



6. What are the climatic zones that Ukraine is divided into in respect to required figures of heat transfer resistance according to the Construction Heating Engineering (Appendix 11-3-79 to Building Code)?
7. What factor characterizes a climatic zone?
8. What is the way to achieve satisfactory values of heat transfer resistance of external filler structures at the modern stage of development in Ukraine?
9. Enumerate the requirements to multilayer panels made of modern thermal insulation materials.
10. List ways of thermal insulation properties improvement of multilayer wall panels, which are routinely used in household construction in Ukraine.
11. What is the fundamental difference between combined thermal insulation of facades that is aired inside and solid thermal insulation without voids, their advantages and shortcomings.
12. When is it advisable to apply thermal insulation to the internal surface of external walls of dwelling houses?
13. What are the drawbacks of thermal insulation of the internal surface of external walls of dwelling houses?
14. What are the advantages and drawbacks of using three layer walls for building dwelling houses?
15. What are the ways of improving thermal insulation properties of windows, flat and sloped roofs of dwelling houses?
16. What are the advantages of 'liquid side sheeting' (also known as thermoshield covering)?

#### 2.4. Heat pumps for decentralized heating and Refrigeration

Classification and basic characteristics of heat pumps. The principle of the heat pump. The use of heat pumps. Schemes heating using heat pump installations.

Literature: [7]; [9]; [15].

##### Method Guide

Heat pumps are a form of heat and transformers designed to produce medium and high coolant capacity used in heat consumption. You need to know the advantages and disadvantages of using heat pumps, types of fluids used in installations with heat pumps. Application of heat pump installations in systems of heat supply is one of the most important intersections with the technology of low temperature thermal energy which

leads to energy saving non-renewable energy sources and protect the environment by reducing CO<sub>2</sub> and NO<sub>x</sub> emissions. The use of heat pumps prospectively in combined heating systems in combination with other technologies using renewable energy sources (solar, wind and bioenergy).

##### Quiz

1. Give the determination of the heat pump.
2. Explain the principle of the heat pump.
3. What fluids can be used in heat pumps?
4. Field application of heat pumps.
5. Draw a schematic diagram of the heat pump and explain purpose of the basic elements of the pump.
6. Advantages and disadvantages of using heat pumps
7. Heat pumps: classification, characterization, use.

#### 2.5. Upgrade walling houses

The theoretical envelope modernization of residential buildings, based on the functional systems approach to energy conservation. Ways of additional insulation device on external walls of buildings.

Literature: [10].

##### Method Guide

Taken energy saving measures in residential buildings lead not only to save fuel and energy resources, but has a social and environmental impact. One of the most important phases saving is additional insulation of external walls of existing buildings. This can be done using different technological solutions and materials. In studying this topic, you must know that insulation, depending on the location of insulation material in the building envelope, is what a "ventilated front" is, and how constructively it hold its technological features. You must know that there are ways additional insulation of external walls of buildings, the advantages of external insulation of buildings and structures.

##### Quiz

1. What are the main modern structural materials used in the construction of houses?
2. What are the factors that determine the cost of heat in the room.
3. Explain how it is possible to reduce heat loss in homes of the old building.



4. Why use an external wall insulation of buildings.
5. Why use ventilation of outside walls of houses.
6. What are the requirements for modern sandwich panels heat insulation materials.
7. Give a general description of Styrofoam- material used as insulation wall panels.
8. Give a general description of polyurethane foam as a material used as insulation wall panels.
9. Give a general description like material used as insulation slabs of concrete.
10. Give a general description of extrusive pinopoli-styrene.
11. Give a general description foamisol material.
12. Explain why the optimum thickness of insulation in terms of savings varies over time.
13. Advantages and disadvantages of metal-plastic windows.
14. Why use "ventilated facades" houses?

## 2.6. Energy Efficiency of Heating Buildings and Ventilation

Heating and ventilation of buildings. Hygienic problems of energy supply houses. Water heating. Air heating. Radiant heating. Generator for autonomous heating. Energy efficient heaters.

Literature: [1]; [2]; [4]; [11].

### Method Guide

Considering the organization centralized and where district heating, to draw attention to the main heating system used in industry and in homes in Ukraine, to know the advantages and disadvantages of each, and the feasibility of using in a particular case.

Studying water heating system, pay attention to the classification of the following parameters, as a way of connecting pipe heaters, heaters connection method relatively basement, location of highways, the direction of movement of water in highways, method of water circulation in the system.

In modern high-rise residential and public buildings value using one-pipe flow and flow-regulated heating system.

You must be able to depict and explain the operation of heating systems with major means nodes of the upper and lower cabling know by what factors can change the temperature in a room with one-pipe heating systems.

For the purpose of energy conservation in decentralized heat supply houses used by apartment horizontal two-pipe heating system. Need to know the benefits of such systems and devices record and tuning it.

When the system of under floor heating is used special mixing device for water is usually installed. You need to know the water temperature changes in the system of decentralized heat and low temperature floor heating system, be able to present the combined heating system.

While considering the problem of air heating it should be noted that the living conditions of the people are directly dependent on the quality of air inside which significantly worse when people stay inside for a long time and it also depends on the as well as the condition of ventilation.

You need to know the requirements of building regulations "Houses" to temperature, relative humidity, traffic and amount of current of fresh air for different climatic zones of Ukraine. Carefully consider the structural scheme of joint air heating and air roof installation.

Note that when using radiant heating systems major factors comfort for people is radiant flux and temperature of the internal surfaces of walls instead of air.

### Quiz

1. What heating systems common in district heating for industrial and residential buildings in Ukraine?
2. Which heating system is most hygienic and easier to use?
3. What are the main advantages and disadvantages of water, steam air, radiant heating panel.
4. What heating system should be used in decentralized heating systems?
5. What are the main advantages and disadvantages of one-pipe heating systems with running heaters.
6. Name the factors which can change the air temperature in rooms with one-pipe heating systems?
7. What are the advantages of decentralized heat supply pipe on a flat horizontal heating.
8. What appliances registration and control panel must be installed when using a horizontal two-pipe heating systems by apartment?
9. What do you know about water heating floor?
10. Why is impractical to create a common system of water pipe heating and water heating floor?



11. Give examples which prove that the air quality is getting worse when people stay indoors for a long time.
12. What ventilation system used in houses in Ukraine? What are its shortcomings.
13. What is a combined system of air heating with aqueous purge mechanical ventilation?
14. What is a roof ventilation-heating system?
15. Explain the appropriateness of beam radiation, heating of large industrial facilities, sports facilities, shops, esplanades and others.

### 2.7. Generator for autonomous heating. Heating appliances

Generator for autonomous heating. Energy-efficient heating appliances. The introduction of metering and regulation of electricity and heat, hot water, natural gas and water use.

**Literature:** [1]; [4]; [7]; [12]; [14–16].

#### Method Guide

The domestic market of Ukraine offer consumers heat-gas generator for different purposes and different capacities for self-heating. They are produced by enterprises of many European companies and joint ventures which are located on the territory of Ukraine.

You need to know the main characteristics, advantages and disadvantages of such heat generators: gas heating devices for air heating, wall flow type gas water heaters (geysers), wall-flow type gas boilers, gas boilers wall with integrated capacitive boiler for 40...60 liters on the flour boilers, gas boilers condensate type, contact type water heaters, automatic boiler Module.

Looking at ways of introducing state metering FER must focus on the problems that exist in the country on this issue, know the main sections of the draft law "On account of fuel energy" to realize that just flat FER can be the basis for economical energy consumption citizens.

They, in turn, can repay the services rendered, not subsidize energy companies, forcing the latter to introduce new technologies for energy saving.

#### Quiz

1. What do you known about types of heat generators heating technology for autonomous heating?
2. Describe gas heating unit for air heating.

3. Describe the wall gas heater of thousands flow type.
4. Describe the wall gas boiler flow type.
5. Describe the wall gas boilers with integrated capacitive boiler 40...60 liters.
6. Describe the floor boilers.
7. Describe gas boiler condensate type.
8. Describe the contact type water heaters.
9. Describe automated boiler Module.
10. What are you known for saving heaters?
11. What are the main sections of the draft law "On account of fuel energy".

### 2.8. Accounting for energy and other resources

Power management. Directions and objectives of energy management. Mapping and energy needs of economic plan. Economic evaluation of energy conservation. State Inspection of energy conservation. Certification of energy-saving facilities.

**Literature:** [1]; [4]; [7]; [8]; [12].

#### Method Guide

The primary means of reducing energy consumption and therefore increase the efficiency of its use is energy management. Mastered the concept of energy management, the main purpose of its implementation is to identify objects energy management and implementation stages of the energy audit.

Analysis of the consumption levels of energy resources includes primary data collection, analysis of the costs of energy resources, analysis of the fate of the cost of energy resources in the overall cost companies determine the cost of energy per unit of output. Define the terms on which it is based on and the stages of the energy audit.

Studying the phase of determining of energy flows, it must be learned that he can not only reveal the full picture of the distribution of energy, but also identify the major consumer and priorities for further work.

Stage consumption registration and monitoring of the use of energy resources is intended to identify possible areas of energy-saving policy of the company. Analysis of energy and the development of integrated energy saving measures can determine the efficiency of energy resources for the core processes in each unit. At this stage, it must begin



the process of forming a package of organizational and technological measures for energy saving.

You need to know the basic types of technological measures and ways of cooperation with the administration towards upgrading energy economy.

At the stage of evaluating and forming long-term plans of the supposed author supports the implementation of energy efficiency measures, comparative analysis of the results achieved in relation to the reference pilot.

We learned the necessity to analyze the overall level of reduction of FER clarification of cost components energy resources Personnel and Administration to form energy-efficient world.

Note that energy audits aimed to develop and implement a range of energy efficiency measures at the company and inspections should only fiscal nature.

The energy management is a complex scientific and methodological support for the survey company.

You must know the basic components of this complex, including: passport technology, circuit power consumption model, a database of energy saving equipment and technologies, regulations on the cost of energy resources.

Focus on the responsibilities of energy manager, planning his work and cycling power management.

Studying the economic evaluation of measures to implement energy management, understand a concept of "initial costs", "operating costs", "old economy", "saving the current operating costs", "payback period".

### Quiz

1. Give the definition of "energy management".
2. What measures involves the concept of energy management?
3. What allows you to achieve the implementation of energy management in the enterprise?
4. What is the subject of an energy audit in the enterprise?
5. What are the stages of an energy audit at the company?
6. Analyze consumption levels of energy resources.
7. Give a brief description of the stage of defining the energy flows.
8. What are the main components of the definition phase power flows.
9. Give a brief description of the stage of the consumption registration and monitoring the use of energy resources.

10. Give a brief description of the analysis stage of the energy flow and the development of integrated energy saving measures.
11. Give a brief description of the stage of evaluation and the formation of long-term plans.
12. What are the responsibilities of energy manager.
13. What documents are worked out for complex scientific and methodological support for the survey company?
14. What should I look for when choosing a metering energy consumption?
15. What account energy appliances are used in your house.

### 2.9. Energy Audit

Energy Audit. The main stages of energy audit firms. The purpose of the energy audit. Calculations of fuel consumed. Analysis of energy flows. Evaluation of energy consumption.

Literature: [1-4], [7-12].

### Method Guide

Energy audit is a research enterprise organizations and individual enterprises on their own initiative to identify opportunities for saving energy and helping the company in the implementation of savings in practice through application of the energy efficiency.

Aim of this topic is to draw attention to the main stages of energy audit of its methodology. When conducting energy audits analyze energy flows in the enterprise, it can not only discover the full picture of the distribution of energy, but also identifies the major consumer and priorities for further work on energy savings.

The main objective of the energy audit is finding opportunities energy efficiency and help entities to identify areas of energy efficiency. Please note that an energy audit is aimed at the development and implementation of complex energy efficiency measures at the company and inspections should only fiscal nature. The results of the energy audit are highlighted in the report of the energy audit.

### Quiz

1. Give the definition of "energy audit".
2. What is the subject of an energy audit in the enterprise?
3. What are the stages of the energy audit company?



4. Give a brief description of the analysis stage of the levels of consumption of energy resources.
5. Explain the essence of a simple energy audit. Who holds and for what purpose?
6. Explain the essence of complex energy. Issues resolved this world view audit.
7. Give a brief description of the stage of defining their energy flows.
8. What are the main components of the definition phase of energy flows.
9. Give a brief description of the stage of consumption registration and monitoring of energy resources.
10. Give a brief description of the phase analysis of energy flows and development of integrated energy saving measures.
11. What are the main sections of the energy audit company report?

### 2.10. Non-traditional and Renewable Sources of Energy

Solar power engineering. Wind power engineering. Small-scale hydro-power engineering. Biotechnologies, waste recovery. Geothermal energy. New technologies of producing energy.

**Literature:** [1–4]; [6]; [7]; [11]; [12].

#### Method Guide

All directions of bioenergetics, energy of wind and ocean, solar and geothermal energy are placed among non-traditional and renewable sources of energy. Such kinds of energy are produced by nature and each of them might replace currently existing fuel and energy supplies.

Over 120 billion ton of dry organic material is made on the Earth a year through photosynthesis, which is equal to 40 billion ton of oil in energy-conversion efficiency.

Over 25,000 wind turbines function worldwide with the total capacity of 3,600 MW which produce 5 billion kW/h of electricity every year.

Geothermal energy supply is estimated at  $8 \cdot 10^{12}$  J which is 35 billion times as much as the annual energy consumption by humankind.

When you study renewable sources of energy, concentrate on problems of using the potential of each kind, learn the Ukrainian resources; remember modern technologies and equipment, be able to demonstrate the advantages of any renewable source of energy over traditional ones. Pay special attention to economic benefits of using each renewable source of energy.

### Quiz

1. Estimate the potential of biomass in Ukraine based on woods.
2. Estimate the potential of biomass in Ukraine based on agricultural vegetable waste.
3. Estimate the potential of biomass in Ukraine based on agricultural animal waste.
4. Estimate the potential of biogas in Ukraine.
5. What are the component parts of a simple biogas house boiler that combined heat and electricity production?
6. Estimate the potential of wind power in the world. What are the problems of using it in Ukraine?
7. Estimate the potential of solar power in the world. What are the problems of using it in Ukraine?
8. Draw the action chart of a heat pump and explain its operating principle.
9. Name non-traditional and renewable sources of energy.
10. How is a renewable energy associated with the activity of the sun?
11. Wind energy installations: classification, main directions of thermal energy.
12. Hydropower as the main branch in Ukraine that uses renewable energy.

### 2.11. Biotechnology, recycling.

#### Geothermal energy. New technologies of energy generation

Biotechnology, recycling. Geothermal energy. Sources of geothermal energy detection zone and the first use. Types of geothermal energy opportunities and energy constraints (economic reasons), practical value (separation of geothermal reservoirs), the principle of geothermal power plants. Hydrogen power. The main advantages and disadvantages of hydrogen used as a fuel. New technologies of energy generation.

**Literature:** [1–4]; [6–10].

#### Method Guide

Resources geothermal heat is  $8 \cdot 10^{12}$  Dzh that exceeds the annual energy world consumption in 35 billion times. Geothermal energy is now used for heating (production processes and food processing industries, heating, etc.) and generate electricity.

Exploitation of geothermal energy is based on previous geological studies to avoid significant financial risk if further capital expenditure.



With the growing demand for energy resources, the depletion of fossil fuels and rising levels of pollution in many countries result in the development of hydrogen energy as an alternative and more environmentally friendly type of fuel, energy. Resource base for hydrogen is quite broad. In addition to the water from which hydrogen can be obtained by electrolysis using electricity and heat to the resource base includes virtually all fossil fuels, various types of biomass, and various waste production, waste and others can be used as a resource base.

### Quiz

1. Draw a diagram of geothermal plants for heat supply and to produce electricity.
2. Where in Ukraine are the main resources of geothermal energy?
3. What do you know about the energy of hydrogen? What are the ways of obtaining hydrogen.
4. The advantages and disadvantages when used hydrogen as fuel.
5. What is an electrochemical process used in fuel cells.?
6. What do you know about geothermal energy? Explain the operation of steam power plants for couple
7. Name the country in which the most used geothermal energy.
8. Biomass and Bioenergy. The basic processes of recycling and biomass.
9. Estimate the potential of biogas production in Ukraine.
10. What are the main elements is schematic diagram of a biogas boiler? Combined production of heat and electrical energy?

## HOMEWORK

Student do homework on his/her own.

Homework assignment consists of the title page, the contents with pages enumerated, the explanatory note of at least 10 pages of the A4 size which includes necessary diagrams, graphic materials, pictures, sketches, plans, layouts and tables. All pages should be enumerated.

### Home task 1

Wet steam with the temperature  $t_2$  from a gas boiler with the efficiency 80 % is fed to the process equipment of a small workshop via a steel pipe with the diameter  $d$ . The temperature in the workshop is  $t_1$ . It is supposed to insulate the pipe with glass fiber and receive investments in  $n$  years.

It is necessary to determine the thickness of the insulation and the pay-off period for this thickness if the price of gas is 0.01 €/kW·h with the equipment running 3,000 hours a year.

The heat-transfer coefficient for the external surface of the insulation is 10 W/m<sup>2</sup>·K. The required cost of the insulation  $c_{in}$  (€/m) depends on the thickness  $x$  (mm) and is calculated by formula:  $c_{in} = 0.2x$ .

### Method Guide

The thicker the insulation, the less heat is wasted; however, the cost of the insulation may exceed financial benefits of this measure. Thus, such problems are solved by determination of the economic thickness of insulation.

The following algorithm of solving the problem should be applied:

The internal heat resistance of the pipe and its sides is neglected:

1. The heat-transfer coefficient for the external surface of insulation is taken as constant for each diameter of the pipe and temperature;
2. The thickness of the insulation is taken as  $x$ , mm;
3. The heat resistance of the insulation and the external surface per unit length is calculated;
4. After the specific capacity of heat waste is determined, the cost of heat waste is calculated;
5. The specific cost of the insulation is evenly distributed along the given number of the years of the investment;



6. General annual running costs of the insulation are determined, which are minimized at the economic thickness;

7. Having calculated the annual cost of heat waste at the economic thickness, the pay-off period of the insulation is determined.

### Example of Problem Solution

For a variant with the following data:

$$d = 60,3 \text{ mm}; t_2 = 200 \text{ }^\circ\text{C}; t_1 = 15 \text{ }^\circ\text{C}; \lambda_{in} = 0,07 \text{ W/m}\cdot\text{K}; n = 5 \text{ years.}$$

1. The heat resistance of the insulation:

$$R_{in} = \frac{\ln(d_{in}/d)}{2\pi\lambda} = \frac{\ln[(60,3+2x)/60,3]}{2\pi \cdot 0,07} = \frac{\ln(1+0,03317x)}{0,44} \cdot \frac{mK}{W}$$

2. The specific capacity of heat waste (per meter of length):

$$Q = \frac{t_2 - t_1}{\frac{1}{\pi d_{in} \alpha} + R_{in}} = \frac{200 - 15}{\frac{1}{1,894(1+0,03317x)} + \frac{\ln(1+0,03317x)}{0,44}} \cdot \frac{W}{m}$$

3. The annual cost of heat waste:

$$C_{an} = Q \cdot \frac{3000}{1000} \cdot \frac{0,01}{0,8} = 0,0375 \cdot Q, \frac{\text{€}}{m}$$

4. The total annual efficiency cost of the insulation:

$$C_{\Sigma} = \frac{C_{in}}{n} + C_{an} = \frac{0,2x}{n} + 0,0375Q, \frac{\text{€}}{m}$$

5. The economic thickness of the insulation is determined on the condition  $C'_{\Sigma}(x) = 0$ , however in practice engineers apply the tabular procedure of calculation, specifying several values of  $x$ , for instance,  $x = 19, 25, 32, 38, 50, 60 \text{ mm}$ .

So, we fill in a table 1 and find the lowest value of the annual efficient cost of insulation.

Table 1

№	Insulation thickness (mm)	Specific capacity of heat waste (W/m)	Annual cost of heat waste (€/m)	Cost of insulation per year of investment (€/m)	Annual efficient cost of insulation (€/m)
1	0	350.5	13.14	0	13.14
2	19	129.0	4.84	0.76	5.60
3	25	111.4	4.18	1.00	5.18
4	32	97.4	3.65	1.28	4.93

№	Insulation thickness (mm)	Specific capacity of heat waste (W/m)	Annual cost of heat waste (€/m)	Cost of insulation per year of investment (€/m)	Annual efficient cost of insulation (€/m)
5	38	88.6	3.32	1.52	4.84
6	50	76.4	2.87	2.00	4.87
7	60	69.4	2.60	2.40	5.00

The economic thickness of the insulation  $x_{ec}$  is 38 mm.

6. The pay-off period of the insulation with the thickness of 38 mm is:

$$n = \frac{0,2x_{ec}}{(C_{an} - C_{anec})} = \frac{0,2 \cdot 38}{13,14 - 3,32} = 0,774, \text{ or } 9,3 \text{ months.}$$

### Variant of Homework Assignment #1

variant #	d, mm	t <sub>2</sub> (°C)	t <sub>1</sub> (°C)	W/m·K	n years
1	68	110	15	0,07	5
2	70	120	16	0,07	4
3	73	127	17	0,07	3
4	76	133	18	0,07	6
5	83	140	15	0,07	3
6	89	143	16	0,07	2
7	95	148	17	0,07	5
8	102	150	18	0,07	4
9	108	158	19	0,07	3
10	114	165	20	0,07	2
11	121	170	15	0,07	3
12	127	175	16	0,07	5
13	133	180	17	0,07	5
14	140	183	18	0,07	4
15	146	185	19	0,07	3
16	152	190	21	0,07	3
17	70	195	15	0,07	4
18	83	150	16	0,07	5
19	95	125	18	0,07	2
20	102	120	14	0,07	6



## Home Task 2

### (Topics for essays on the subject)

1. Energy saving as a factor of environmental security of a country. Climate changes. Greenhouse gas effect.
2. Energy saving as a factor of economic security of a country.
3. Law of Ukraine on Energy Saving. Standardization and regulation in the energy saving sphere.
4. Complex State Program of Energy Saving in Ukraine. Its purpose, main directions and tasks.
5. Program of State Support of Development Non-conventional and Renewable Sources of Energy. Its purpose, main directions and tasks.
6. Fuel and energy complex of Ukraine. Types of fuel. Types of energy supplies. Energy saving potential of Ukraine.
7. Fuel and energy complex of Ukraine. General situation in the complex and main related tasks. Energy saving potential.
8. Fuel and energy complex of Ukraine. Mining complex of Ukraine.
9. Fuel and energy complex of Ukraine. Oil and gas complex of Ukraine.
10. Fuel and energy complex of Ukraine. Gas transportation system of Ukraine.
11. Fuel and energy complex of Ukraine. Electric power system of Ukraine.
12. Fuel and energy complex of Ukraine. Heat-and-power engineering system of Ukraine.
13. Fuel and energy complex of Ukraine. Hydro-power engineering system of Ukraine.
14. Fuel and energy complex of Ukraine. Nuclear power engineering system of Ukraine.
15. The concept of energy saving policy in Ukraine. Main directions of energy saving policy in Ukraine.
16. Main directions of energy saving in different branches of the national economy of Ukraine (household communal sphere, heat supply, industry).
17. Comparative analysis of centralized and decentralized power supply.
18. Cogeneration. Main benefits of large-scale introduction of cogeneration in the country.

19. Heat utilization. Heat utilization plants.

20. Utilization of excessive gas pressure in gas pipelines using turbine expander plants.

21. Energy saving in construction and the household and communal sphere. Estimation of energy consumption by the construction sector compared to total consumption of fuel and energy in Ukraine.

22. Heat efficiency of buildings. Promising directions of improving heat efficiency of buildings.

23. Improvement of heat efficiency of buildings by practical choice of buildings fencing. Comparative analysis of internal and external thermal insulation of walls.

24. New energy efficient insulation materials.

25. Decentralized power supply systems. Hot-water, forced-air, ray, infrared heating.

26. Decentralized power supply systems. Heat generators for autonomous heat supply.

27. Metering of energy supplies consumption as the major task of energy saving.

28. Energy management: directions and tasks. The main duties of an energy manager at an enterprise.

29. Energy management. Stages of energy management implementation at an enterprise.

30. Energy management. Drawing up a map of energy supplies consumption at an enterprise.



Навчальне видання

## ЕНЕРГОРЕСУРСОЗБЕРЕЖЕННЯ

Методичні рекомендації  
до виконання домашніх завдань  
для студентів напрямку підготовки 6.050604  
«Енергомашинобудування»  
спеціальності 7.07010301  
«Технічне обслуговування та ремонт  
повітряних суден і авіадвигунів»

(Англійською мовою)

Укладачі:

ВОЗНЮК Андрій Петрович  
ГРЕКОВ Павло Іванович  
КАПІТАНЧУК Костянтин Іванович  
ЯСИНІЦЬКИЙ Едуард Петрович  
ЯСИНІЦЬКА Ірина Едуардівна

В авторській редакції

Технічний редактор *А. І. Лавринович*  
Комп'ютерна верстка *Н. В. Чорної*

Підп. до друку 21.08.2014. Формат 60x84/16. Папір офс.  
Офс. друк. Ум. друк. арк. 2,09. Обл.-вид. арк. 2,25.  
Тираж 100 пр. Замовлення № 160-1.

Видавець і виготівник  
Національний авіаційний університет  
03680. Київ-58, проспект Космонавта Комарова, 1.

Свідоцтво про внесення до Державного реєстру ДК № 977 від 05.07.2002