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# Methodological Problems For Developing A Model For The Development Of The Thermal Energy System In Mongolia

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***Abstract.****The article looks at the current situation of the fuel and energy sector in Mongolia from the point of view of providing heat to consumers and focuses on further improvements. In the context of our country, the problem of heat supply is one of the most important problems facing the energy sector and we need to develop a methodology to address this issue as an thermal energy system(comprehensive heat supplying systems of energy sector). Therefore, it is important to approach the study of an object by the method of the general and mathematical systems theory, shortly named in this article systems analysis.This will be improve the thermal energy sector and, in particular, the subsystems of sources, networks and consumers, which are elements that make up the heat supply economyin the towns and settlement, and in parallel, review their interconnections will be detect influencing factors. On this basis, it should be studied and decided by modeling using an integrated approach, method and methodology aimed at improving economic, environmental, technical and technological indicators and reliability by improving the organizational structure in accordance with the specific conditions of the primary heat and power resources of our country, transport infrastructure, location of consumers and power consumption. In this article attempts to develop a methodological basis for modeling thermal energy systems in such an approach.*

***Keywords.****Primary energy resource, thermal energy, heat sources, networks, ecology, transport infrastructure.*

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## I. Introduction.

It is important to meet the thermal energy demands of consumers by choosing a method that has the scope, technical and technological solutions that meet its unique conditions in Mongolia, and saves the cost of heat production.This problem is due not only to the climatic conditions of our country, but also to the peculiarities of living in a vast area with a unique lifestyle and poor economic structure.Therefore, the problem of heat supply in the sphere of life and production cannot be solved by the methods and technologies of countries with large populations, densely populated territories and multi-structured economies, regardless of this feature.Therefore, it is necessary to solve the problem of thermal energy in an effective way and form that reflects our uniqueness. In general, with the exception of a few countries in Northern Europe, the technology and equipment used in the heating are observed being outdated.

However, in the current situation of scientific and technological development, new and advanced technologies and equipment are rapidly entering the practice of heat production, distribution and consumption.To date, the cogeneration power plant is being updated, which is considered the most advanced form of heat production.There is a new approach in the field of research on the production technology for heat and electricity by cogeneration (CPP) and separately (Heat only plants (HOP) orboiler houses (BH)).

The cogeneration method, which was introduced in the Soviet Union in the 1930s, has been one of the most effective ways to meet the heating demands of large cities since the 1970s, with the techniques and equipment become more sophisticated in countries such as Denmark and Sweden.In our country, which has developed cities in connection with the country's industrialization, the best solution was to solve the problem of electricity and heat production based on the cogeneration (CPP).

However, the problem of heat supply in sparsely populated, industry undeveloped rural aimags, soum centers and settlements remains unresolved.There are also many districts in large cities that are not covered by the district heating (cogeneration) system.

Currently, in urban planning practice, the methodology of solving the problem of heat supply is based on a number of indicators used in the centrally planned economy, such as specific heat consumption per capita, specific thermal characteristic of the building (definition of heat per unit volume), etc.As a result, local heating plants and boiler houses have become unprofitable in market conditions, and large heating plants are no longer in use.A large number of low-capacity hot water boilers with old technology, which do not meet modern energysaving and ecological requirements, and often operate with budget support, have become dominant, and or self-solving direction is prevailed for each consumers own heating.

Although in recent years the government has paid much attention to improving the heat supply of aimag centers, so the same type of heat source has been planned and implemented regardless of their specifics and separately from the network.In this way, as a rule, implemented network improvement projects.

As the research results and conclusions of some researchers in the field of energy security in Mongolia show, the situation of the region and part of electricity and heat supply to consumers is in the pre-crisis stage [1].They are highlighted, that the indicator that contributes to the reduction of energy security is the complex structure of the consumer network, due to the fact that the heat generated by the centralized source reaches 95% in the heat balance of the territory.Although this is true, this is only the case in a few large cities with district heating.All other settlements have partial or independent heat supply based solely on local coal resources.

These realities show that it is time to take a new approach to heat supply and address it with socially oriented, inexpensive, adapted to market and local conditions, by as a new technologies.Therefore, there is a need to plan heat supply in general from a new perspective, and to study and solve this problem using a methodology based on updated indicators for assessing efficiency.Creating a new approach to heat supply is not only about reducing costs (although it is important), but also about limiting the impact of energy sources on global warming, at least by reducing air pollution in cities and towns. As a it's result improving the ecological status of the surrounding macro- and micro-environments and protecting public health.Therefore, the development of the thermal energy sector is a key issue involving multilateral social relations. Therefore, the approach should take into account climatic conditions, primary energy resources, transport infrastructure, new and advanced techniques and technologies are intruducing in the field of heat supply, and the situation of the urban population and entrepreneurship.

## II. Research methodology.

Although the production and supply of energy, including thermal energy, has become clear in terms of the using resources, sources, techniques and technologies, and can be considered to have already answered all the problems on the basis of thermal engineering theory, but the picture is still observed different in the real life.Therefore, it is necessary to develop a theoretical basis for a comprehensive approach to heat production and supply.This means that the decision will be made taking into account the above factors.This problem is related not only to thermodynamics, heat-mass transfer, heat transfer, mechanical processes, but also to environmental phenomena.On the other hand, there will be an increase of the impact, of social production, people's living standards, the growing demand for material resources and the process of urbanization, and the processing and use of primary energy resources. And climate, weather, geography, infrastructure development, social and even economic factors are also begins to influence the heat supply.

Therefore, the solution of the problem should begin with a detailed consideration of the relationship between the Fuel and Energy Complex (FEC) and its components.Mongolia's FEC is, in principle, composed from the fuel and energy complexes of regions and economic provinces (FECREPs) and has its own fuel base and units for generating electricity and heat (TPPs, CPPs, HPPs and other REPs).

An integral part of the fuel and energy complex is the power system, which contains the CPP and is integrated with the thermal energy system. The electricity and heat sectors can be supplied with fuel from both national and regional mines. And, large cities and industrial facilities are supplied with heat from central heating systems of CPP, while non-central areas or not covered parts and most settlements have independent (or local/localized)heating systems (IHS).The above-mentioned functional relationship between them is shown in the form of a block diagram (Figure 1).

Therefore, in the current situation, when the cogeneration power plant plays a key role in the power generation structure of our country, it is necessary to consider the electricity and thermal energy systems in close connection. We know that especially in winter, when the heating load of large cities such as Ulaanbaatar is high, the excessive amount of heat supplied by the CPP can limit electricity production. This will lead to many problems, such as increasing electricity imports.

Therefore, one of the new directions in the development of thermal energy systems is to supply heat from other sources during the peak hours of winter electricity load, to regulate heat demand at the system-wide sources and to develop and introduce storage technology in the district, section and consumers.

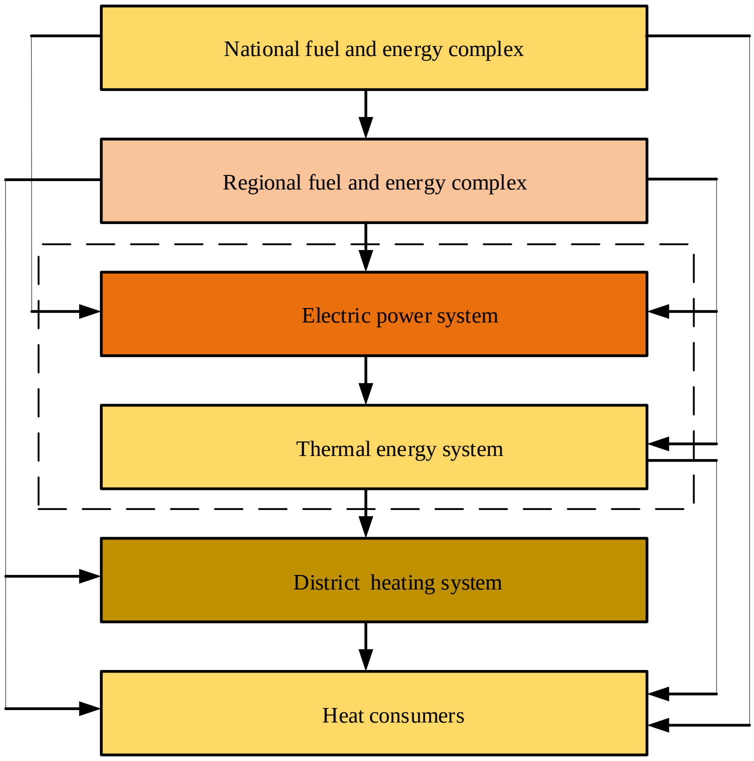


Fig. 1. Position of the thermal energy systems in the Fuel-energy complex

From the FEC, for optimization and studing by the systems analysisapproach of the large-scale economic, energy and social spheres structure of the “Thermal energy system” to be operated at the national, regional and local levels, taken together with the source or separately, and using each of the following subsystemts that make it up can be analyzed.This is the methodology used in large system theory.Subsystem “fuel supply”: coal mines; road network; location of settlements on the territory (Figure 2).

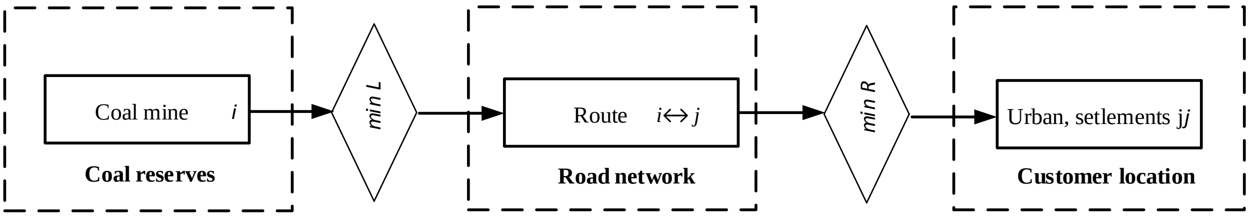


Figure 2. Structure of the “fuel supply” subsystem

Hence, the “fuel supply” subsystem can be considered as a linear system.In other words, any consumer can transported coal from particular mine by any route, and the exact route depends on the length of the road and the difficulty of the road, but in principle, transit and return are not possible. The objective function of the subsystem is to determine the cost of delivering the primary (chemical) energy-containing product (any type of fuel) from the block (coal) to the block "customer location", i.e. how much the product will cost the consumer.
To meet the heat demand in location j (city, settlement) from the i[th] resource (mine) of the k-type fuel, which is the energy transfer medium, to delivery the product $A_k$ by the route i↔j with a ($l_{i\leftrightarrow j} \leq L_j$) condition, at distance $l_{i\leftrightarrow j}$ is formulated in the form of a “objective function” to determine the cost of delivery $S(A_{k,\ j},\ R_{i\leftrightarrow j})$. This applies equally to all urban and settlement consumers, unless a particular user specifies a particular mine or imposes restrictions on a particular type of fuel.
This may be written in the following expressions with the necessary restrictions.

$$\left(3_{i,j,k}\right)_{opt} = \mathrm{Y}_{i,k} \cdot \left[k_{\mathrm{y}}\right]_{i,k,(j)} \cdot \left[k_{e,f}\right]_{k,i} + S_{p,k} \cdot \left[k_{\mathrm{3c}}\right]_{i,j} = min \qquad (1)$$

Where $\mathrm{Y}_{i,k}$- the market price of the specific fuel purchased at the particular mine, $\left[k_{\mathrm{y}}\right]_{i,k,(j)}$- the coefficient of the specific price (discount) for the fuel set by agreement (contract) between the supplier and the consumer, $\left[k_{e,f}\right]_{k,i}$- coefficient of conversion of the fuel to equivalent fuel, $S_{p,k}$- transportation cost of delivering one ton of fuel to the consumer by p type vehicle, $[k_{sr}]_{i,j}$- coefficient taking into account the specifics of the route .

Based of the study, for the j location (city, settlement) of the specific area, the lowest price $\left(\text{З}_{j,k}\right)_{\text{онвч}}$ reflecting the transportation costs determined by formula (1) is calculated for each type of fuel k.

$$(\text{З}_{\text{онвч}})_{j,k} = \langle (\text{З}_{k})_{min}\ , k = 1,2, \ldots K_1 \rangle \qquad (2)$$

There are two versions depending on the overall purpose of the study.First, calculate the actual costs of the existing thermal energy system in the form in which they will be incurred while operating under the current scheme;second, to determine the minimum value of local, regional, and national costs by doing mines, energy-containing product types, transportation schemes and options, and other changes, organization and coordination. Can be formulated such two types of objective functions.

The next step in the modeling of a “thermal energy system” is determine the most efficient of using which one of the fuels (k≤K1) (transported from the mine) and the k-type (K1 <k <K2) energy resources, which are included in the series (3.7), and used for heat production on the “Heat supply economy” subsystem of the heat consumers in the j-location of the city and its district.

$$\left(\text{З}_{kj,}\right)_{opt} = \langle (\text{З}_{k})_{min}\ , K_1 < k < K_2 \rangle \qquad (3)$$

Energy resources at the site include renewable and secondary energy sources.

**Subsystem “Heat supply economy”:** This subsystem includes the following main parts: They are, the cogeneration power plant (CPP) for the heating system; for other heat supply systems, thermal plants (Heat only plants) (HOPs); boiler house (BH); small hot water boilers (SHB) on the consumer; heating network; heat exchanger station (HES); heat distribution center (HDC); user input; heat consumers. In principle, this can be illustrated by the following general schematic diagram, which includes all the cases, consisting of three blocks: “source-network-user” (Figure 3).

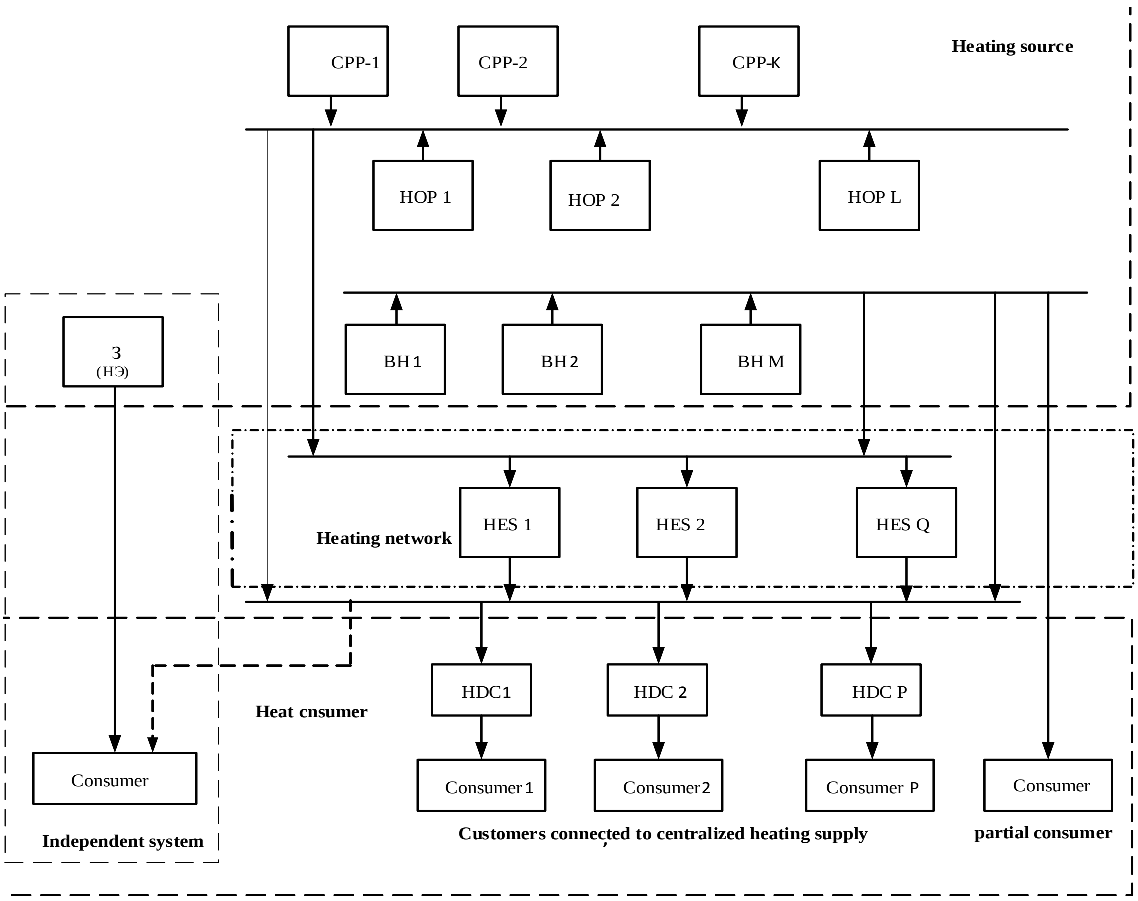


Figure 3. General structure of “Heat supply economy” subsystem

The “heat source” block of the subsystem includes all the CPPs, thermal plants, boiler houses, and the consumers' own small hot water boilers (SHB), which are to the size of the specific urbanazed and industrial areas.All heat sources, except for the consumes own small hot water boilers, are connected to the consumers through the “heating network” block of the subsystem.The “heat consumer” block of the subsystem includes all consumers connected to the central and partially heating system and receiving heat from their own small hot water boilers.

The Heat supply economy subsystem shall have a database that contains information on all "equipment" related to its internal components. This is an auxiliary quality block with purpose for entering data about equipment.This allows the dependences of all equipment and devices involved in the modeling (energy characteristics of the boiler; energy characteristics of the turbine; heating network hydraulics characteristic) to enter in the appropriate form for modeling (algebraic equations; regression equations; dependencies; tables; matrices; numbers, etc.) will create a database.However, since we are constructing a mathematical imitation model of the system, certain forms of network extensions do not play a decisive role.But, its hierarchical structure and, through it, the hydraulically dependent and independent connection of the source to the consumer, and all possible variants, such as mixed schemes, should be reflected in the mathematical model.

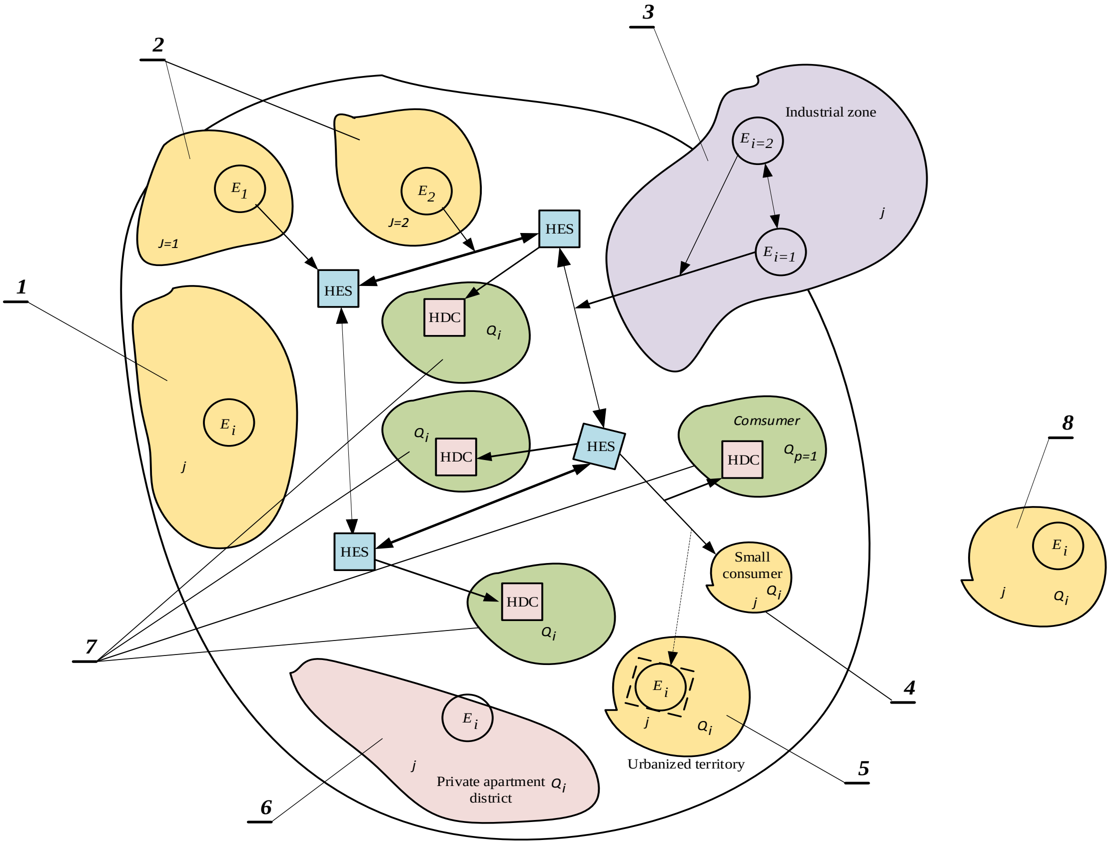


Figure 4. Types of heat supply in urbanized areas

In reality, a heat supply economy in an urban area is a consumer or micro-district with an independent heat source (1), a consumer or micro-district connected to an integrated heat source network (2), an industrial zone with an independent heat source (3), and no network-connected heat source small consumers or micro-districts (4), as well as small consumers, which changed their heat sources and connected to the grid (5) , private apartment districts with own heat sources (6), large consumers (7) districts connected to the network through heat exchangers, and can be in the form of a small settlement (8) with its own heat source remote from urbanized areas (Figure 4).

As shown above (Figure 3), the "Heat supply economy" subsystem includes all types of heat sources, as a K number of CPPs, L number of Heat Only plants (HOPs), and M number of boiler hauses (BHs).

**"Heat sources" block.** The components include the boiler, its fuel and water treatment and ash, slag removal and flue gas cleaning parts, and double-extraction turbines (with industrial and heating receivables) (Figure 5).

The technological innovations of heat sourcescan be divided into the following three main groups. first, its technological scheme is changed in its entirety; second, its technological scheme was retained and change its basic equipment (for example, will change boiler technology and coal burning technology, condenser and its cooling system, and flue gas cleaning technology, etc.); and third, to fully process solid, liquid, and gaseous wastes from heat generators andconverted into one source for the production of goods.

Today, we need to introduce the second version to new heat sources. The first step is to use a new type of boiler.This type of energy boiler includes circulating fluidized bed and vortex (cyclone)combustion technology boilers. This is an environmental friendly technology that can reduce sulfur ($SO_2$) and nitrogen ($NO_x$) oxides in the flue gas by simplifying the combustion technology of coal used in heat generators and combustion at the low temperature (850-1000°C).In principle, this can apply to all types of heat generators (CPPs, HOPs, BHs, and individual small hot water boilers at the consumer). Figure 5 shows the most general case (in the form of a CPP) that is appropriate for the structure of the heat source.If the heat source is a TP or BH, the turbo generator block (TG), and if the small hot water boiler (3) is on the consumer, the elements that do not belong to it are removed from the block and to create a suitable version of the "heat source" subsystem.

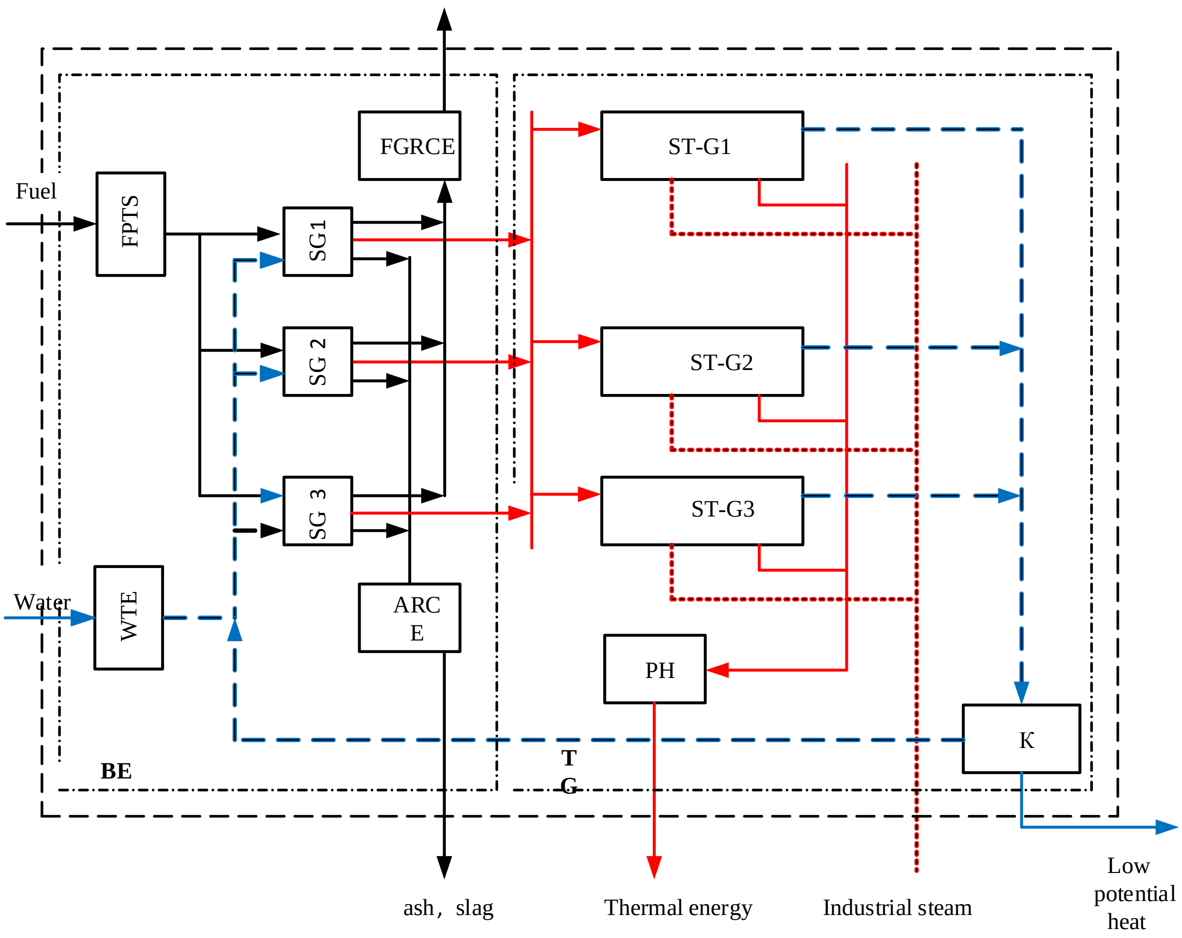


Figure 5. Common structure of the "heat source" block of the heating facilities subsystem.

Costs associated with heat production of a heat sources.

$$(3_{hs})^{total}_{i,j} = b^{te}_{ef\,k} \frac{Q_{i,j}}{(\eta_{hs})_{i,k}} \left(3_{opt}\right)_{i,j,k} \tag{4}$$

Cost of thermal energy

$$(3_{hs})^{unit}_{i,j} = b^{te}_{ef\,k} \frac{1}{(\eta_{hs})_{i,k}} \left(3_{opt}\right)_{i,j,k} \tag{5}$$

Where $b^{te}_{ef\,k}$- specific equibalent fuel consumption for heat production with k-type fuel of the sources, $Q_{i,j}$ - heat capacity of the sources.

In the mathematical imitation model, the actual efficiency in the technical economic kharacteristics of the heat sources can be determined by entering the estimated correction factor of the amount for increasing or decreasing of the nominal value depending of factors, for example the new technology and the operating conditions. Therefore:

For CPP

$$\eta_{hs} = \eta_{CPP} k_{fp} k_{wt} k_{sg} k_{nh} k_{wh} \text{ ;(5)}$$

Depending on whether the thermal plant has a steam generator or a hot water boiler

$$\eta_{hs} = \eta_{TP} k_{fp} k_{wt} k_{sg} k_{nh} k_{wh} \text{ or } \eta_{hs} = \eta_{TP} k_{fp} k_{wt} k_{hwb} k_{nh} \text{ ;} \tag{6}$$

For the boiler house

$$\eta_{hs} = \eta_{BH} k_{fp} k_{wt} k_{hwb} \text{ .} \tag{7}$$

Here, $\eta_{CPP}$ , $\eta_{TP}$ , $\eta_{BH}$- the nominal value of the efficiency of the CPP, TP and BH; $k_{fp}$- the correction factor that for improvements of efficiency by improving fuel preparation systems ($k_{fp} = \eta'_{CPP}/\eta_{CPP}$ ,), where $\eta'_{CPP}$-

the efficiency of the CPP after reconstruction); $k_{wt}$- also improved water treatment system ($k_{wt} = \eta'_{CPP}/\eta_{CPP}$); $k_{sg}$-also improved steam generator ($k_{sg} = \eta'_{CPP}/\eta_{CPP}$); $k_{nh}$-also improved heating facilities ($k_{nh} = \eta'_{CPP}/\eta_{CPP}$); $k_{wh}$- introduced technology to use all and some types of waste heat ($k_{wh} = \eta'_{CPP}/\eta_{CPP}$); $k_{HWB}$- improved the hot water boiler of TP ($k_{HWB} = \eta'_{TP}/\eta_{TP}$).

**"Heating network" block.** The heat supply network consists of q number of heat exchanger stations (HES) and heat distribution centers (HDC) connecting p number of customer groups. In addition, the heating network can have a double or single-closed frame structure to ensure reliability heat supply from a heat source to consumers, a radiant structure to regulate hydraulic adjustment, and a direct heating connection to the source for individual consumers (Figure 2).The inclusion of heat exchange stations in the structure of the heat supply system has the advantage of dividing a large network covering the urbanized territory into heat supply districts, each of which has a hydraulic regime and a hierarchical control structure.In addition, the next level hierarchy can be created by establishing heat distribution centers for heating of grouped consumers, which will allow scientific and technological advances to penetrate the heating network and create a technical (elemental) base for monitoring, calculating and adjusting heat consumption at each section. As a result of these technico-technological innovative changes, the "thermal energy facilities" subsystem has evolved into a mixed system composed of different from each other hierarchical levels (hierarchical structure) with each level has a cellular structure.In the structure scheme shown in Figure 4, the "E" heat generator (5), which is very low in ecological performance, can be technically upgraded and connected to the centralized and partial heat supply system ("independent system" in Figure 4).Alternatively, other "clean energy carriers" or primary energy resources, such as solar energy and low-potential heat from the environment, can be directly converted into ecologically clean "independent heat supply systems". Or If connected to the "centralized and partial systems", its load can be lightened by disconnecting it or by leaving the same and using it as an additional source.

Aims of mathematical modeling is reduce costs by selecting a variety of schemes depending on the heat load of the consumers connected to the heating network and the accompanying heat transfer medium rate.The cost of a particular section of the network

$$(3_{hn})_{i,j} = Q_{i,j}\, e_{Q,L} L_{i,j}. \tag{8}$$

Here $Q_i$- the total heat load of the consumers connected to the specific part of the HN; $e_{(Q,\ L)}$ - the value transferred per unit length of the heat transfer cost line; $L_i$ - the length of the network heating line.

Heating network transmission efficiency:

$$\eta_{HN} = \eta_{hl}^{\mathrm{I}}\eta_{hes}\eta_{hl}^{\mathrm{II}}\eta_{hdc}\eta_{hl}^{\mathrm{III}} \tag{9}$$

Here $\eta_{hl}^{\mathrm{I}}, \eta_{hl}^{\mathrm{II}}, \eta_{hl}^{\mathrm{III}}$ - efficiency of heat network for transportation of heat transfer mediums through the network, $\eta_{hes}$ - efficiency of heat exchanger station, $\eta_{hdc}$ - efficiency of heat distribution centers.

At the each hierarchical levels of the network, efficiency taking into account linear (per unit length) heat losses varies depending on the parameters of the circulating water, its the flow rate and line parameters.

**"Heat consumer" block.** Heat consumers vary in scope, capacity, and type of load, as well as geographical location.Therefore, there are many versions to meet their heat demands.Which of these versions is more effective and economical, energy, and ecological indicators when taken separately during distributing heat from the source to the consumer can be determined by the research of specific criteria reflected in the objective function using systems analysismethodology based on the mathematical model. To do this, many of the following parameters will need to be considered as indicators of heat consumers. Including:

Heat consumers area, heat load density, difference in heat load between the largest and smallest consumers, source location, distance to the farthest consumer, topography, fuel base, and finally the climatic features, that have a significant impact (duration of the heating season, outside air temperature and annual graphic of heat load) and heat loss in buildings and apartments.And the structure of the industrial heat consumption and its share in the total heat load is affect. Taking these into account, in addition to calculate the estimated load of heat consumers, it will be decided which version of heat supply to offer to the individual customer or group of consumers. The cost of the heat at the consumer

$$(3_{cons})_{i,j} = (3_{hn})_{i,j}\left(1 + \frac{1}{\eta_{hn}}\right) \tag{10}$$

The study of the "Heat supply economy" subsystem of mathematical modeling begins from determination of their heat load ($Q_i$,) on the part of the consumers in each heat supply district (Figure 4).The choice of heat supply system version should considered the specifics of heat consumers, especially in settlements and towns.The peculiarity of the construction of the aimag center and local cities of our country is that they cover a large area and consist 1- 3 floors, a small number of 4-5 floors buildings, usually small.In other words, the heating load density of buildings in urban areas is low.As an example, the following table summarizes the results of the survey on the construction status and heating load of some aimag centers and local cities (Table 1).

**Table 1.** Indicators of heat consumers in some centers and settlements

| City and | Heat supply district | Of construction | Calculated heat | Density of heat | Annually heat |
|---|---|---|---|---|---|

| settlements | area, hectare (ha) | Density, $m^2$/ha | Average number of floors | load, Gkal/h | load, Gkal/(h·ha) | load $Q{\cdot}10^{-4}$,Gkal/ha |
|---|---|---|---|---|---|---|
| Ulaangom | 99,7 | 1002,9 | 1,80 | 25,7 | 0,258 | 6,7 |
| Khovd-1 | 83,0 | 377,6 | 2,83 | 8,3 | 0,100 | 2,0 |
| Muren | 148,6 | 888,8 | 1,66 | 26,7 | 0,180 | 7,4 |
| Nalaikh | 131,5 | 887,0 | 2,29 | 26,4 | 0,201 | 8,5 |
| Zuunmod | 131,5 | 1017,3 | 1,82 | 26,9 | 0,205 | 8,1 |
| Tsetserleg | 89,4 | 2746,0 | 2,39 | 48,8 | 0,546 | 16,5 |
| Berkh | 29,6 | 1320,3 | 1,61 | 6,9 | 0,234 | 2,0 |
| Choir | 100,8 | 1112,9 | 2,57 | 24,5 | 0,243 | 6,1 |
| Dalanzadgad | 122,0 | 778,9 | 1,82 | 15,2 | 0,125 | 4,1 |

This shows that the average indicator of building floor is 1.6-2.4 and the density of construction 377.6-2746.0 $m^2$/ha, and proves the above mentioned.This reduces the heat load density (0.1-0.546 Gcal/(h·ha)).The low heat load density makes it difficult for choose a centralized heating system, which often results in a partial supply of heat from several sources.As a result, the length of the heat transmission line increases, which increases the investment and operating costs depending on the type of extension, and the heat loss of the open extension line is more and affects the quality of heat supplied to consumers.This leads to the choice of a partial heat supply system or an independent heat supply vertion. In some cases, at the current stage of technical and technological development, it is possible to use an alternative system to provide consumers by heat generated on their own. These include solar systems, heat pumps, liquefied petroleum gas, and night electricity.However, the using of district heating systems in large cities, aimag centers, and some local cities has always had economic and ecological advantages.

## III. The results.

As a result of the methodological research, an optimization model of the thermal energy system, as shown in the following block diagram, was developed (Figure 5).This can be called a dynamic model for selecting the optimal development version for the thermal energy sector, or a “mathematical imitation model for systems analysisin the thermal energy sector”. It is necessary to select and create a software environment to implement the developed model in the future.This model

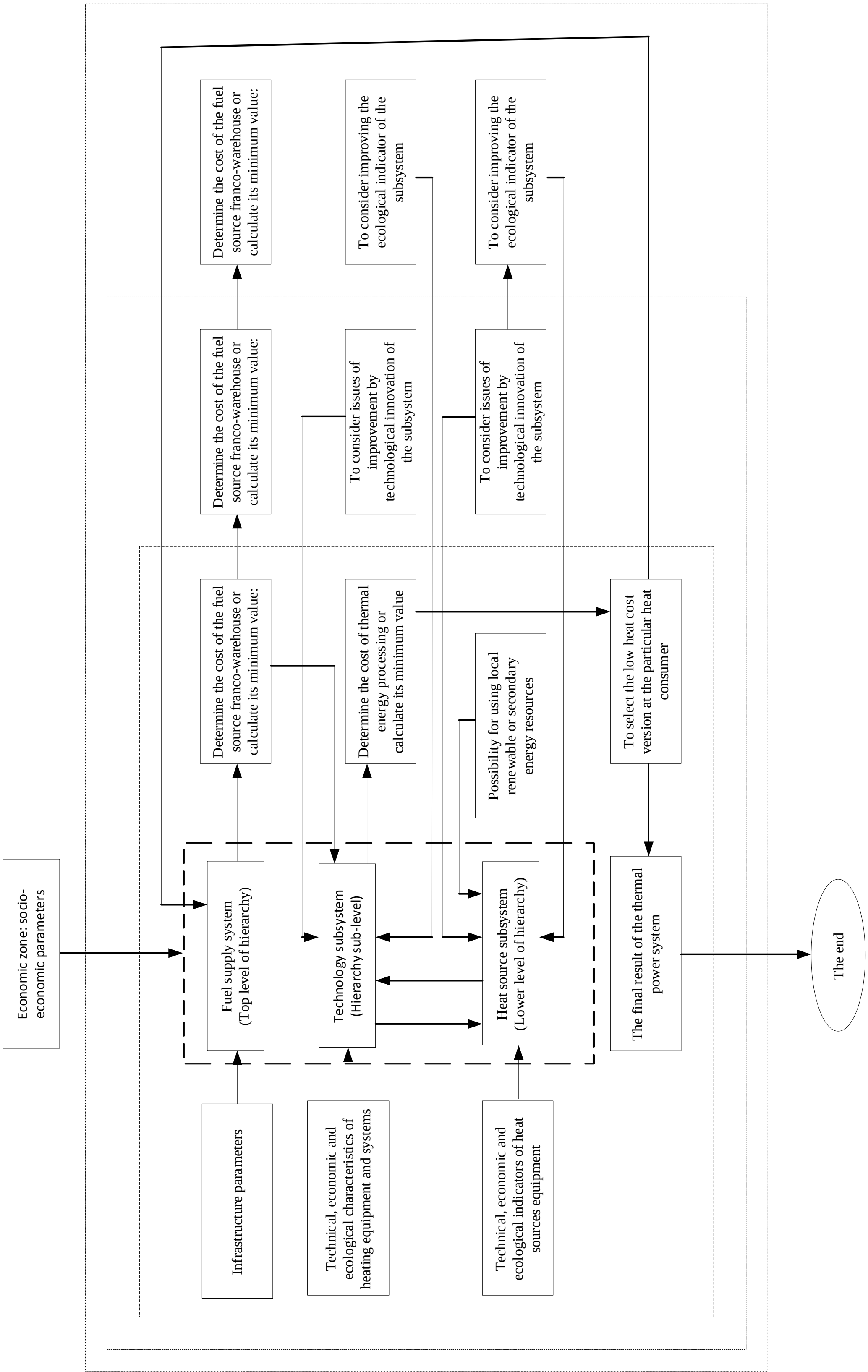


Figure 5. Imitation model for system analysis of "Thermal energy sector"

can be used to analyze factors affecting from all angles on the thermal energy system.As the imitation model database, "Socio-Economic Parameters" block, includes technical and economic indicators of the country's (regional) main fuel deposits ( coal deposits and mine production resources, mining, data on energy fuels from concentrating and processing plants).But the "infrastructure parameters" block, includes the centralized structure of the plant, its location, and the schemes of the transport infrastructure network connecting them to the mines, as well as the parameters that determine the distances (routes) and road conditions.The following two blocks of the database include technological advances, equipment, devices, and their technical, economic, and ecological characteristics that have been introduced into the thermal energy facility. And this includes a so-called "internal" database that separates the heat generator and enters its parameters.For heating networks, there are two types of optimization policies: branched and circular, but the most important is the efficient fragmentary problem of the heat supply system [2]. One of the economic and technical criteria is used here.

Therefore, the objective function of the research for heat supply system is more complex for comparation to the fuel supply system.Will consider, the individual aspects such as improving the efficiency of the scheme, optimizing the thermodynamic system [3], and improving its ecological performance or by combination of these etc. And depending on how these are considered, the objective function can be formulated differently.

The criteria may depend on the extent to which the thermal energy system is considered nationally or regionally, or in a large city, and finally in a small settlements.In summary, first of all, there are can be proposed two types of goals that need to be addressed first.Two directions can be proposed, first, to determine the lower value of the exploitation and investment transferred costs for determining the direction of exploitation and renovation, and second, to organize the heat supply network by efficiently dividing consumers according to the location by purpose for determining the technical and technological development. Technological criteria play a key role in the optimization of the latter direction, and are expressed by the flow rate of circulaming water in the heating network, pressure and the hydraulic capacity of the pump, which provides circulation.This model calculates the efficiency of the thermal energy system of a particular city or settlements. Therefore, the main importance of it is to consider the efficiency of the thermal energy system as a large-scale system and use it as a methodolgy for determine the current situation and future development trends.

## IV. Conclusion.

1. One of the most pressing issues in our energy sector today is processing its development model with a scientific and technological basis, in line with the research area, which takes into account the specifics of Mongolia's thermal energy system.
2. The issue is considered in close connection between the two subsystems, fuel supply and heat supply economy, under the influence of many factors, and an optimization research methodology has been developed.Hereby, it possible to divide the heat supply economyinto “source-heat network-consumer” blocks, create possible and realistic alternatives for each of the its elements and their connection diagrams, model them by method system analysis and determine the optimal option.
3. Using the mathematical imitation model of the thermal energy sector developed as a result of this study, efficient structures and schemes at any stage of design and renovation of national and regional or large urban and, finally, small urban heat supply economycan be developed in accordance with the set goals and objectives.
4. A block diagram of the actual implementation of the model is included, and an appropriate algorithm can be developed to conduct modeling studies using current computer software platforms, such as the MS Windows operating system.
5. The method of mathematical dependencies for the computational methodology of the subsystems included in the model has been developed and is not covered in the article, as it is not relevant to the topic.

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