Analysis of the structure of energy sources (solid fuel, natural gas) in individual low-rise buildings planned for construction in the Republic of Sakha (Yakutia)

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Abstract. This article analyzes the structure of energy sources (solid fuel, natural gas) in individual low-rise buildings planned for construction in the Republic of Sakha (Yakutia). The indicators for the number of houses intended for heating with solid fuel (coal) and the number of houses intended for heating with natural gas have been clarified. Differences in different age groups of future homeowners are taken into account. The results confirm the preference for natural gas as an energy source in the new individual houses planned for construction in the Republic of Sakha (Yakutia). These studies can be used in the development of development programs in the relevant area.

1 Introduction

Heating residential buildings in regions with cold climates is an important task. The temperature in the Republic of Sakha (Yakutia) in winter drops to -50°C, which confirms the need to analyze the structure of energy sources (solid fuel, natural gas) in individual low-rise buildings planned for construction in the Republic of Sakha (Yakutia). At the same time, it is necessary to take into account the differences in different age groups of homeowners. Older homeowners often opt for solid fuels (coal) because of conservative views. In connection with the ongoing gasification, natural gas is coming to an increasing number of settlements in the region, and is becoming a competitor to traditional solid fuel (coal). In this paper, the structure of energy sources (solid fuel, natural gas) in individual low-rise buildings planned for construction in the Republic of Sakha (Yakutia) is analyzed on the example of two types of energy sources - solid fuel (coal) and natural gas.

2 Materials and Methods

In order to conduct a series of observations aimed at analyzing the preferences of homeowners (in the segment of individual low-rise buildings planned for construction in the Republic of Sakha (Yakutia)) when choosing energy sources for home heating - solid fuels...
(coal) and natural gas), a corresponding questionnaire survey of two hundred consumers of energy sources was conducted. 

The survey was conducted in three different age groups of consumers of energy sources for home heating:
- the first group of consumers of energy sources – age 18-30 years;
- the second group of consumers of energy sources – aged 31-45 years;
- The third group of consumers of energy sources is the age of 46-65 years.

The age breakdown of energy consumers was carried out to take into account the difference in preferences of energy consumers in different age groups.

All surveyed consumers of energy sources were provided with questionnaires that included the question: which energy source option is preferable for you:
- The first option is natural gas;
- The second option is solid fuel (coal).

For the purposes of collecting and processing data from a survey of consumers of energy sources, various methods used in the works were considered [1-27].

3 Results and Discussion

3.1 Results of a survey of consumers of energy sources for home heating

3.1.1 The First Group of Consumers

The results of the survey of the first group of consumers of energy sources for home heating (18-30 years old) are presented in Figure 1.

![Figure 1](https://example.com/fig1.png)

**Fig. 1.** Results of a survey of the first group of consumers of energy sources for home heating (18-30 years old).

3.1.2 The second group of consumers

The results of the survey of the second group of consumers of energy sources for home heating (31-45 years old) are presented in Figure 2.
Fig. 2. Results of a survey of the second group of consumers of energy sources for home heating (31-45 years old).

3.1.3 The Third Group of Consumers

The results of the survey of the third group of consumers of energy sources for home heating (46-65 years old) are presented in Figure 3.

Fig. 3. Results of a survey of the third group of consumers of energy sources for home heating (46-65 years old).

\[
r_s = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}
\]  

(1)
3.2 Discussion

The results of surveys of consumers of energy sources – solid fuels (coal) and natural gas for home heating – provide data that the use of natural gas is already quite widespread among consumers, while consumer preferences in the segment of energy sources in terms of solid fuels (coal) and natural gas are unevenly distributed between the selected options (Table 1).

Table 1. The results of surveys of consumers of energy sources are solid fuels (coal) and natural gas (for heating a low-rise residential building).

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>Type of energy source</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Natural gas</td>
</tr>
<tr>
<td>First</td>
<td>67</td>
</tr>
<tr>
<td>Second</td>
<td>53</td>
</tr>
<tr>
<td>Third</td>
<td>49</td>
</tr>
</tbody>
</table>

Figure 4 shows the averaged quantity of the survey data from the energy sources of solid fuels (coal) and natural gas used for home heating.

![Figure 4](image)

Fig. 4. The average quantitative indicator of the survey data of consumers of energy sources is solid fuels (coal) and natural gas for all age groups.

From the data obtained (Figure 4) it follows that the average value of the priority of energy sources – solid fuel (coal) and natural gas (for heating a low-rise residential building) is: solid fuel (coal) – 44%; natural gas – 56%.

4 Conclusions

The study presents data on the preferences of energy consumers when choosing between two available energy sources – solid fuel (coal) and natural gas (for heating a low-rise residential building). The data reflect the preferences of consumers of energy sources (for home heating) living in the Republic of Sakha (Yakutia) of energy sources for home heating is a data limitation. Analysis of the preferences of energy consumers when choosing between two available energy sources – solid fuel (coal) and natural gas (for heating a low-rise residential building) He showed that the distribution between the compared energy sources – solid fuel (coal) and natural gas (for heating a low-rise residential building) in the preferences of consumers is distributed as
follows: 44% and 56%, respectively. These studies can be used in the development of development programs in the relevant area.

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