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A Study on the Transition to a Consumption-Based Heat Billing System

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Abstract - The reform of energy prices and tariffs, including the modernization of household heating tariffs, has become one of the most pressing issues in Mongolia's energy sector today. It is time to transition to a consumption-based heat billing payment system that reflects market costs. The price of heat energy for household consumers in Ulaanbaatar has not changed since 2019. It is 2.8 times lower than the actual cost. This research paper reflects on the innovation of energy price and tariff design. It presents a study on transferring thermal energy to a market-cost consumption-based payment system. It has become a pressing matter to align the current heat price and tariff categories with market principles. This entails increasing the prices of certain categories that do not align with the cost of purchase from the licensee's tariff and the cost of purchase from the source. Additionally, it involves exempting the heat energy prices and bringing them into line with market principles.

Keywords - energy tariff, heat cost allocator, heat consumption, heat metering

Хэрэглээнд суурилсан дулааны төлбөрийн тогтолцоонд шилжих боломжийн судалгаа

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Хураангуй - Эрчим хүчний үнэ, тарифын дизайны шинэчлэл тэр дундаа ахуйн дулааны эрчим хүчний тарифын дизайныг шинэчлэх асуудал нь өнөөдөр эрчим хүчний салбарын тулгамдаж буй асуудлуудын нэг болсон төдийгүй дулааны эрчим хүчийг зах зээлийн өртөг бүхий хэрэглээнд суурилсан төлбөрийн тогтолцоонд шилжүүлэх томоохон сорилттой нүүр тулж байна. Улаанбаатар хотын ахуйн хэрэглэгчдийн дулааны төлбөрийн тариф 2019 оноос хойш өөрчлөгдөөгүй нь бодит өртгөөс 2.8 дахин доогуур болсон үзүүлэлттэй байна. Энэхүү судалгааны өгүүллээр эрчим хүчний үнэ, тарифын дизайны шинэчлэлтийн талаарх эргэцүүлэл болон дулааны эрчим хүчийг зах зээлийн өртөг бүхий хэрэглээнд суурилсан төлбөрийн тогтолцоонд шилжүүлэх боломжийн талаарх судалгааг толилуулна. Одоогийн мөрдөж байгаа дулааны үнэ, тарифын ангиллыг зах зээлийн зарчимд нийцүүлэх, тусгай зөвшөөрөл эзэмшигчийн тарифт суусан зардал, эх үүсвэрээс худалдан авах өртөг шингэсэн үнэд хүрэхгүй байгаа зарим ангиллын үнэ тарифыг нэмэх, цаашлаад дулааны эрчим хүчний үнэ тарифыг чөлөөлж зах зээлийн зарчимд нийцүүлэх нь чухал асуудал болоод байна.

Түлхүүр үг - эрчим хүчний үнэ, халаалтын зардал хуваарилах хэрэгсэл, эрчим хүчний хэрэглээ, дулааны тоолуур

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I. Introduction

In the past 30 years, there has been a significant increase in population migration to urban areas in Mongolia. Urbanization has reached a rate of 70%, which is higher than the average urbanization rate of 50% in other Asian countries. Rapid urbanization has led to the expansion of cities, but infrastructure struggles to keep pace. Ulaanbaatar hosts over half of Mongolia's population and contributes to 63% of the country's GDP[1].

Additionally, Mongolia's energy consumption and per capita GHG emissions from raw coal are higher than those of other countries with similar economic potential and income levels. It is worth noting that over 80% of electricity and 97-98% of heat energy are generated from coal. This is due to the availability of abundant coal reserves, and the heat supply of urban areas was mainly planned by a centralized district heating system.

For instance, in Ulaanbaatar, where householders account for over 50% of the total consumption within the district heating system, their ability to regulate heat energy usage is severely limited. Less than 1% of all consumers utilize heat meters to pay, based on actual consumption. In addition, the heat loss of prefabricated buildings built before 2000 exceeds the current norms and standards by 2 to 2.5 times. This discrepancy significantly undermines the overall efficiency of the heat supply system and exacerbates resource shortages. By the end of 2023, the demand from consumers connected to Ulaanbaatar city's district heating system exceeded the installed capacity by 33%, highlighting a significant inadequacy in the system's reliability and capacity to meet heating needs.

The reform of energy prices and tariffs, including the modernization of household heating tariffs, has become one of the most pressing issues in the Mongolian energy sector today. It is time to transition to a consumption-based heat billing payment system that reflects market costs.

In accordance with the Paris Agreement, numerous countries have established a sub-goal of reducing carbon emissions, which are a significant contributor to global warming. This reduction must be achieved while maintaining a balanced amount of emissions and emissions (Net-zero). The decarbonization of heating and cooling is of paramount importance for the achievement of net-zero greenhouse gas emissions by 2050.

A few scientific publications focus on the developmental trends of the energy sector, including the development of heat supply systems, the impact on carbon emissions, and energy tariffs [1-4]. For instance, Anna Billerbeck and others [5] conducted a comprehensive analysis of the regulation of ownership of the centralized heat supply system, policy system, tariffs, and policies and regulations on greenhouse gas emissions in 23 European countries. This was in conjunction with the World Bank-funded “Europe and Central Asia Toward a Framework for the Sustainable Heat Supply Transition” project. This analysis encompassed examining heat supply systems in Europe and Central Asia, the systems affecting carbon reduction, and the formulation of recommendations [6].

II. Overview of consumption-based billing system

The efficiency of Ulaanbaatar city's district heating system contributes to the mitigation of power shortages while also incentivizing responsible consumption and improving demand-side management practices among consumers. Conversely, the adoption of consumption-based tariffs aligned with real market costs for thermal energy will stimulate increased efforts and investments directed at enhancing the energy efficiency of buildings. Furthermore, it will provide substantial support for Mongolia's commitment to its "Nationally Determined Contribution" (NDC) in the construction sector, as pledged to the international community.

A. International experience

To learn from the experience of European nations, the European Energy Efficiency Directive 2012/27/EU of October 25, 2012, advocated for the mandatory installation of heat meters by all end-users to facilitate private consumption registration (Article 9). In Germany, the implementation of a consumption-based heat billing system was observed to trigger a significant shift in consumer behavior, resulting in an approximate 20% reduction in heat energy consumption compared to fixed tariff structures. Similar findings were echoed in experiments and studies conducted across other European countries such as France, Sweden, Poland, and Italy, validating the notable change in heat consumption behavior, and closely mirroring the outcomes witnessed in Germany (~20% savings). While the collective results showcase a considerable impact, it's evident that even greater savings can be attained through the regular provision of information to consumers. Therefore, it has been demonstrated that providing information and training to residents is effective in driving behavioral changes [7-8].

The international professional organization recommends that developing countries undertake a comprehensive assessment of the current situation from multiple perspectives to successfully implement a transition to a consumption-based payment system for heating and to ensure equality for consumers. Therefore, the main conditions and problems before the transition are defined as follows:

1. *Infrastructure challenges and investment cost:* Transitioning towards a consumption-based billing system requires adequate (necessary) infrastructure and equipment, including necessary meters and sensors to accurately measure consumption, ability, and flexibility to respond to changing demand. Depending on the condition of the heating system, the necessary investment of implementing a consumption-based billing system, including meter installation and technology upgrades is high and poses a significant barrier for both service providers and consumers.

[1] https://data.worldbank.org/country/mongolia?locale=mn

2. *Consumer resistance:* Consumers may resist the transition due to concerns about increased costs, perceived complexity, or a lack of understanding and awareness of the benefits of consumption-based billing. This leads to skepticism and resistance. Collecting and managing consumption data raises privacy and security concerns as well. Protecting sensitive information and addressing privacy issues is crucial for gaining public acceptance.
3. *Lack of regulatory framework:* The absence or inadequacy of regulatory frameworks to support consumption-based billing may complicate the transition. Clear regulations are needed to govern billing practices, metering standards, and consumer rights.
4. *Resistance from suppliers:* Traditional billing models may be more financially advantageous for heating service providers. Often suppliers enjoy sole supplier privileges due to network ownership and/or absence of alternatives. Transitioning to consumption-based billing may require new pricing models and financial incentives to encourage suppliers to invest in the necessary upgrades.
5. *Political will:* Resistance from various stakeholders, including heating service providers, regulatory bodies, and authorities is often a barrier. Consumption-based billing potentially raises concerns of putting a higher burden on low-income households. Addressing issues of economic inequality and ensuring affordability for all consumers is critical for a fair transition.
6. *Weather variability:* In regions with extreme weather conditions, heating consumption can vary significantly. Establishing fair billing practices that account for weather-related fluctuations in consumption can be challenging.

Addressing these barriers requires a coordinated effort involving government agencies, regulatory bodies, service providers, and consumers. A well-planned strategy, effective communication, and the development of supportive policies can help overcome these challenges and facilitate a successful transition towards consumption-based billing for heating.

B. Why is consumption-based heat billing important?

The consumption-based billing (CBB) is a simple principle where consumers pay according to their actual usage of the product/services. CBB is the opposite of a subscription-based model under which consumers receive services for infinite use at a flat rate (e.g., TV, radio streaming/broadcasting, some phone subscriptions, internet, etc.). The CBB is standard for electricity and water billing. Consumers use electricity per their needs and pay per consumption volume. In a district heating context, this means that consumers use and pay for the thermal energy units they consume for heating their properties.

Consumption-based billing *for heating* is important for several reasons, as it offers various benefits to consumers and the broader community. Here are some key reasons why consumption-based billing for heating is important:

Consumer empowerment: CBB offers the highest degree of consumer empowerment and unlocks the potential and benefits of demand-side energy efficiency. In many transition economies district heating systems are still supply-driven and heating is neither metered nor controlled by the consumers. District heat production is determined by the operators (CHPs, thermal plants, and boilers) according to technical standards and does not follow actual customer demand. Heat distribution is unbalanced most buildings are either over- or under-heated.

District heating systems require large investments and where there is no feasible alternative enjoy monopoly privileges and consumers are accustomed to pay for heating bills irrespective of the quality of and/or actual demand for heating. The heat demand is seasonal by nature (high when the outside temperature drops and low when warm outside). In a supply-driven system, particularly where district heating has overloaded capacity the produced heat is distributed to clients resulting in undersupply when demand grows and oversupply when demand drops, exactly the opposite of the consumer's demand.

CBB promotes transparency in billing practices. Consumers can see exactly how much energy they are using and how it contributes to their bills, fostering trust between service providers and customers. This usually translates into a timely and full collection of bills.

Fairness and equity: Consumption-based billing ensures that individuals pay for the amount of heating they use. This promotes fairness and equity, as those who use more energy pay proportionally higher bills, and those who use less pay less. The absence of metering and controlling of usage results in inequitable payments by the consumers. While price (tariff) is one mechanism for differentiating consumption it often leads to unintended consequences. The absence of CBB combined with simplified billing methodology may result in inequitable payments across consumer groups (industrial, residential, commercial) and consumers (depending on building energy efficiency).

Unlocking of demand-side energy efficiencies: CBB unlocks the potential of demand-side efficiencies, including direct financial incentives for consumers to adopt energy-efficient technologies, upgrade insulation, and make other changes to reduce their heating consumption. This encourages a more sustainable use of resources. Building energy efficiency measures have significant potential. The International Energy Agency (IEA) estimated that only less than 20% of construction energy efficiency potential is realized. In other words, 80% of the potential remains untapped.

Energy conservation: Billing based on actual consumption encourages individuals to be more conscious of their heating usage. This can lead to increased energy conservation as people adopt practices to reduce unnecessary heating, contributing to overall resource conservation. Square or volume meter billing models may not provide a strong incentive for individuals to minimize energy waste. Consumption-based billing encourages users to take measures to reduce heat loss and adopt energy-saving

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technologies and/or practices.

Optimization on the supply side and resource efficiency: CBB reflects the actual costs of providing heating services. It allows supply-side operators to more accurately distribute the heating costs, and costs associated with infrastructure maintenance, fuel, and other operational expenses among consumers based on their usage. Further suppliers are better informed and equipped for optimizing the heat supply. Hence, CBB unlocks both energy demand- and supply-side efficiencies.

This translates to revenue stability for supply-side operators. For heating service providers, CBB can offer a more stable and predictable revenue stream. It allows them to align their income with the actual demand for heating services, making financial planning more reliable. Furthermore, accurate data on individual consumption patterns can help heating service providers plan and invest in infrastructure more effectively and optimize resource allocation.

Environmental impact: Unlocking both supply and demand-side energy efficiencies, and promoting energy conservation contributes to a reduction in overall energy consumption. This, in turn, can have positive environmental effects by lowering GHG emissions and promoting sustainable energy practices [9]. CBB can facilitate the integration of renewable energy sources into heating systems. It encourages the adoption of renewable technologies and helps create a more sustainable and environmentally friendly energy mix.

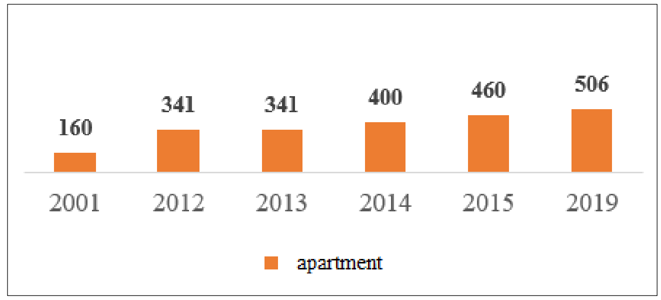
In numerous transition countries, including Mongolia, district heating is provided using a subscription-based model. This is due to several technical, financial, legal regulatory, and governance-related challenges. It is of the utmost importance to address potential challenges, such as affordability for low-income households and the need for robust regulatory frameworks, to ensure a fair and successful transition. Overall, the move towards CBB aligns with broader goals of sustainability, efficiency, and responsible resource management.

III. ENERGY TARIFF POLICY FOR DISTRICT HEATING

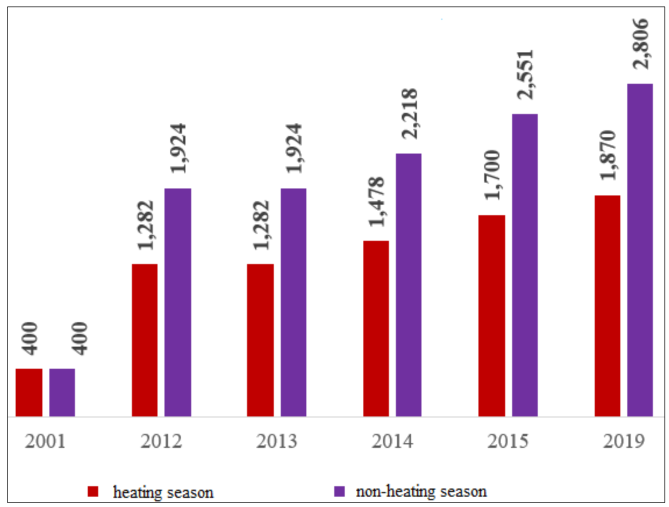
By the end of 2023, a total of 62 legal entities, including 59 private sector companies, Ulaanbaatar District Heating Company (UBDHC), Housing and Public Utilities of Ulaanbaatar city (OSNAAUG), and the Mongolian-Russian 'Ulaanbaatar Railway' Association (UBTZ), were operating with special licenses for heat distribution and regulated provision of heat [10].

Heat generation of the district heating system in 2023 produced 8.51 million Gcal of heat, of which UBDHC purchased 7.68 million Gcal of thermal energy at the seasonal differential wholesale tariff approved by the Energy Regulatory Commission (ERC). This was then sold to licensee OSNAAUG and 59 private sector companies at wholesale prices under contracts approved by the ERC (each energy license holder applies different tariffs).

The research shows that out of 305,691 consumers connected to the district heating system, only 6254 have heat meters. The remaining consumers calculate heat energy based on square meter or volume sources. Among the consumers without heat meters, 32.3% or 96.7 thousand consumers have a 2-pipe collector heating system, which allows them to install heat meters and change tariff categories [11].



a) Tariff for heating, tug/m^3 (without heat meter)



b) Sanitary hot water, tug/person

Figure 1. Changes in tariffs for household consumers

According to Resolution No. 123 dated March 25, 2019, of the ERC, the tariff for sale to households in UB city is 3421 tug/GJ or 506 tug/m^2. The heat tariff for sale to industries and enterprise organizations was approved by Resolution No. 516 dated October 28, 2022. It is 9314 tug/GJ or 604 tug/m^3. In 2016, enterprises provided 13% cross-subsidization to household consumers. However, due to changes in consumer tariffs and the installation of heat meters by enterprises in 2019, cross-subsidization decreased to around 6%. In November 2022, the heat tariff of industrial enterprises increased by 28%, but household tariffs remained unchanged. As a result, the amount of cross-subsidy continues to increase. The tariffs of household consumers in UB have not changed since 2019, which is 2.8 times lower than the actual cost. Figure 1 reflects the changes in tariffs for household consumers.

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In 2012-2022, thermal energy tariffs increased by an average of 46%. The increase was based on factors such as product costs, the country's economy, and consumer income. However, despite these increases, the tariffs have not yet reached the level of covering their costs.

During the implementation of the above tariffs by household consumers, there may be a decrease in sales revenue if a consumer installs a heat meter and changes the tariff category. Therefore, it is urgent to reduce the difference in sales revenue between tariff categories to ensure the financial and economic stability of the energy sector. As of 2023, there are 14,400 industrial and enterprise organizations without heat meters, and 285,200 consumers of households, out of a total of 299,600 users. Of these, 32.3% of consumers are technically able to install heat meters. The heating system of these users employs a two-pipe collector system, thus enabling the installation of a heat meter and the reclassification of the tariff category. Consequently, the number of consumers with heat meters is relatively limited. Prior to the full implementation of the metric tariff, the current metric tariff will be increased for household consumers to a range of 30-89%, for industrial enterprises to a range of 64-72%, and further to the unit cost.

IV. Metering of Heat Consumption and Regulatory Environment

The primary challenge for Mongolia in implementing a consumer-based payment system is the heating system within the building. In UB, the heating system is either vertical or horizontal. For horizontal distribution systems, heat meters can be installed on household input collectors. However, in the case of vertical distribution, a solution can be seen whereby heat meters can be installed at the general entry point of the building, with heating cost distributors (allocators) installed in the radiators of each room.

A. *Metering with heat meter*

As of December 31, 2023, 13,464 buildings were connected to the district heating system in UB. Of these, 6,763 were residential buildings, and 302,567 families resided there. According to research, only 547 households in UB city have heat meters. Of these, 96%, or 523 households pay for the heat they use. The installation of heat meters and the implementation of consumption-based payments will not only result in economic savings for consumers but will also place an additional burden on the centralized heat supply system and facilitate the connection of new customers.

The subject of the study is located in Sukhbaatar District, Seoul Street, Building No. 12, as depicted in Figure 2. A total of 17 families reside in the building, with all residents equipped with heat meters. The total floor area is 1817.4 meters squared. The results of the study comparing the actual heat consumption calculated by the 2023 measure with the calculation of the area size are presented in Figures 4 and 5. Figure 5 presents a comparative analysis of the fees associated with the consumption of thermal energy. Additionally, the heat meters of the households are shown in Figure 3.

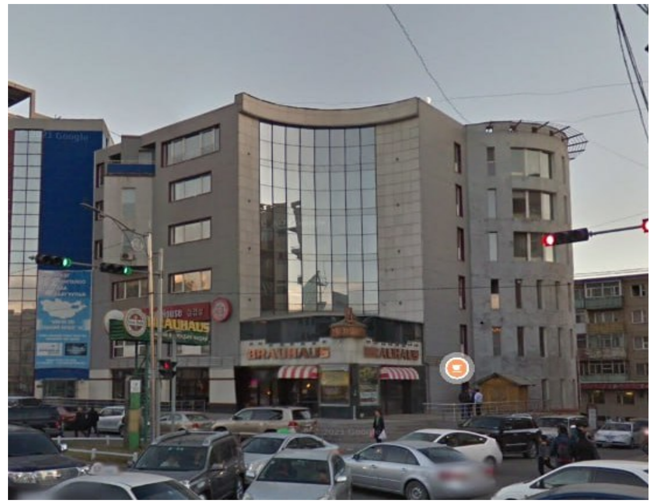

Figure 2. The object of the study – Building #12

Figure 3. Household heat meters

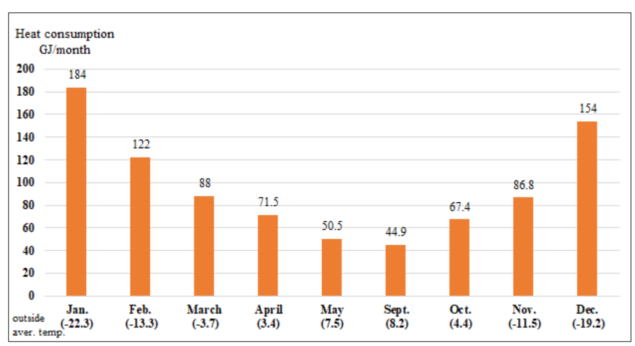

Figure 4. Real heat consumption of consumers during the heating season

In 2023, the actual consumption of heat by the households of building No. 12 was 869.1 GJ, as indicated by the meter.

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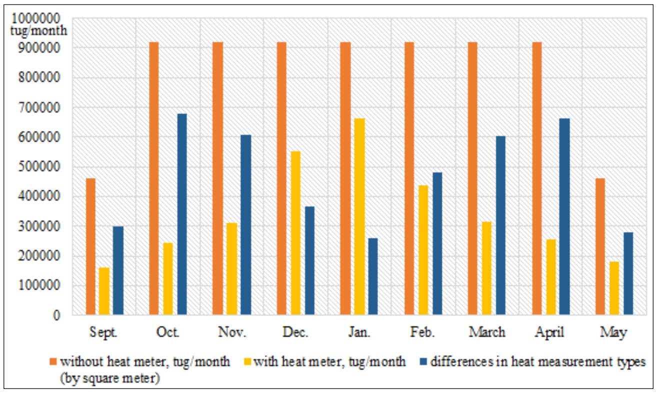

Figure 5. A comparison of thermal energy consumption fees

In 2023, the total heat payment calculated for the 17 households of the building was 3121.7 thousand MNT. This represents a 57.6% saving in comparison to the amount of heat energy that would have been calculated in bulk depending on the residential area.

B. Metering with heating cost distributors (allocators)

The heating system in prefabricated and brick residential buildings constructed before 2000 is typically configured with a one-pipe scheme. This system accounts for 32% of all apartments in Ulaanbaatar, or 203,730 households, which represent 68% of all household consumers. The statistical information on prefabricated buildings is shown in Table 1. Buildings with a one-pipe distribution system require modification, especially if the building has many floors. Consumers with this distribution scheme cannot install tools to measure and adjust heat consumption. In such cases, it may be possible to transition to a consumption-based billing energy payment system, provided that optimal solutions for internal system changes are provided and resolved. An allocator is a method for distributing heating costs. It may calculate heat payments based on consumption for all household consumers who are unable to measure their consumption with heat meters (such as apartments and public buildings with vertical heating distribution systems).

TABLE I. STATISTICAL INFORMATION ON PREFABRICATED BUILDINGS

Type of buildings	number of prefabricated housing	substation-CTP		
		mixing loop	orifice	Total
5 story	280	269	164	433
9 story	210	445	332	777
12 story	40	39	1	40
Sum	530	753	497	1250

In a one-pipe system, thermostatic valves must be mounted with a bypass. Without this, thermostatic valves would shut off the entire vertical heating circuit when they close themselves. With a bypass, thermostatic valves merely reduce or open the flow to the radiator. Only with thermostatic valves can the full potential of efficiency measures be realized. The entire technical equipment package, including heat substations, thermostatic valves, and heat cost allocators (HCA), is a functional unit. Figures 6 and 7 illustrate the schematic representation of a one-pipe heating system, comprising a thermostatic valve, HCA, and bypass.

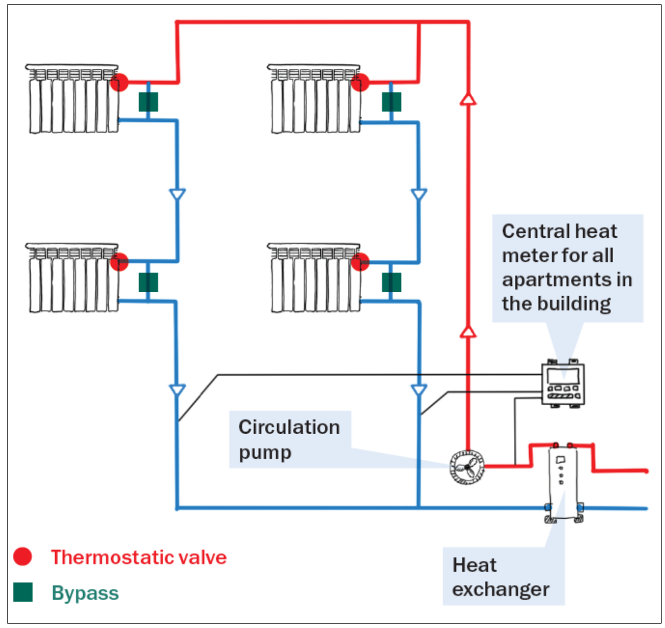

Figure 6. One-pipe heat distribution system

Figure 7. Thermostatic valve, HCA, and bypass in a one-pipe system

MNS EN 834:2020 is a standard that provides a tool for determining the use of room heaters. According to the standard, allocators do not require testing or calibration in the same manner as heat meters. Based on the experiences of countries that have introduced allocators, no re-testing or adjustment is done during the warranty period issued by the manufacturer, and it is not required from a legal standpoint [12-13].

C. Regulatory environment

Before the enactment of the regulation "Heating, ventilation, and air conditioning" (Construction Norms and Rules of Mongolia - BNbD 41-01-02), which was adopted by Order No. 360 of 2003 from the Minister of Infrastructure, no regulation had been integrated into construction codes and regulations regarding equipment in consumers' energy bills. Article 3.15 of the "Heating, Ventilation, and airconditioning" rule (BNbD 41-01-02) states: When planning separate heating for each apartment the 2-pipe heating system, device for adjusting, controlling, and calculating shall be included in each apartment, but its implementation has been insufficient. This regulation was updated in 2011. BNbD 41-01-02 was subsequently annulled by Resolution No. 84 from the Minister of Road Transport, Construction, and Urban Development on March 21, 2011.

In Article 6.1.3, it is specified that the heat supply systems for residential, public, and industrial buildings must incorporate measuring devices to control the building's heat costs. According to the design specifications, individual heat nodes with measuring devices will be installed to calculate and monitor the heat consumption for each type of room and tenanted areas within the same building. The heating systems for residential buildings will be designed to cater to the heat consumption and adjustment requirements of each apartment.

In Article 3.1.1, the term "apartment" as defined in Article 3 of the Law on Housing, ratified on April 22, 1999, encompasses public or private residential buildings, apartments, or homes.

As indicated above, the *discrepancy between the terms* specified in the law and the building norms and regulations for building design has been entirely overlooked in the legal framework concerning the installation of heat meters for every household in an apartment building.

V. Conclusions

Transitioning from traditional heating consumption to a consumption-based payment system residential building involves a series of steps, starting from the approval of building norms and regulations for building design, extending to the involvement of design authors, the state commission overseeing the process, and the signing of energy supply contracts for these buildings, up to the connection of the heat to their respective networks. There is an urgent need to introduce a new control and regulatory system to ensure the maintenance of energy measurement and adjustment tools. The responsibility of the Ministry of Construction and Urban Development, along with its implementing agencies and energy supply organizations, is particularly crucial in this regard.

The team suggests the following measures as the initial steps towards transitioning to a consumption-based heat billing system, based on research and analysis of the current state of UB city's district heating system, household users' measuring and adjustment tools, construction norms and regulations for building design, and their implementation:

1. Define terms consistently in both laws and building norms to clarify different concepts.
2. Assess compliance between laws and regulations regarding building energy efficiency.
3. Upon acceptance of residential buildings by the state commission and issuance of technical conditions for energy supply, relevant institutions should assess whether the building energy certificate and measuring and adjustment equipment are fully installed, and issue the necessary technical conditions.
4. Re-examine the conditions for payment using heat meters installed at the general entrance of apartments, and develop procedures by the law.
5. Include provisions for losses in the transmission and distribution lines to increase network efficiency by reducing technical losses, and incorporate these losses into the tariff of the distribution organization.
6. Introduce energy tariffs for consumers to enhance the utilization efficiency of heat network resources.
7. Consider and implement measures such as creating connection fees for newly connected users and establishing investment sources for transmission and distribution lines.

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References

[1] V. Bürger, J. Steinbach, L. Kranzl, A. Müller, "Third-party access to district heating systems -challenges for the practical implementation", Energy Policy vol. 132, pp. 881–892, Sep. 2019, https://doi.org/10.1016/j.enpol.2019.06.050
[2] S. Buffa, M. Cozzini, M. D'Antoni, M. Baratieri, R. Fedrizzi, "5th generation district heating and cooling systems: a review of existing cases in Europe", Renew. Sustain. Energy Rev., vol. 104, pp. 504–522, Apr. 2019, https://doi.org/10.1016/j.rser.2018.12.059

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DOI: 10.59264/jet.v2i1.53

[3] Agata Oltarzewska, Dorota Anna Krawczyk, "Analysis of the influence of selected factors on heating costs and pollutant emissions in a cold climate based on the example of a service building located in Bialystok", Energies vol. 15 (23), Dec. 2022, https://doi.org/10.3390/en15239111

[4] Janne Suhonen et al., "Energy, cost, and emission saving potential of demand response and peak power limiting in the German district heating system", International Journal of Sustainable Energy vol. 42:1, pp. 1092-1127, 2023, https://doi.org/10.1080/14786451.2023.2251601

[5] Anna Billerbeck et al., "Policy frameworks for district heating: A comprehensive overview and analysis of regulations and support measures across Europe", Energy Policy vol. 173, Feb. 2023, https://doi.org/10.1016/j.enpol.2022.113377

[6] "Europe and Central Asia Toward a Framework for the Sustainable Heating Transition", The World Bank, ESMAP, 2023, http://documents.worldbank.org/curated/en/

[7] Directive 2012/27EU

[8] Clemens Felsman, Juliane Schmidt, Tomasz Mroz, "Effects of consumption-based billing depending on the energy qualities of buildings in the EU", Dec. 2015

[9] N. Tsolmon, O. Bavuudorj, D. Ulemj, "Energy Demand and Greenhouse Gas Emissions Analysis in Mongolia: A LEAP Model Application", Journal of Energy Transition, vol. 1, no. 1, pp. 7-12, Dec. 2023, https://doi.org/10.59264/jet.v1i1.34

[10] Statistics 2023, Energy Regulatory Commission

[11] "Barrier analysis for transitioning to consumption-based heat billing", Research Report supported by GGGI, UB, Mongolia, 2024

[12] "Making District Heating Happen: Empowering Users through Fair Metering", Policy paper on Infrastructure, European Bank for Reconstruction and Development, 2018

[13] "Heating cost distribution tool for determining the use of room heaters. Household appliances" standard, MNS EN 834:2020

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