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Estimation of Effective Demand of Population for Energy Sector Services in the Far East[1]

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Abstract. The article is devoted to estimating the effective demand of population for energy sector services in the Far East. It shows that objective factors connected to geographical and climatic conditions, settlement and housing provision in the region, explain high consumption of energy resources: electricity – 33% higher than country average per capita, heat – 2.3 times higher. The article shows that only electricity market allows population to control the demand, unlike the heat market, where payments are made according to standards and using metering devices is restricted by the specifics of communal infrastructure of housing. Despite the attempts to control the growth of tariffs in the Far East, their nominal size is 2-4 times higher than country average. The article states that the potential for growth of population income in the region is limited and its rate cannot compensate for the growth of tariffs. It is shown that even with the 75% standard of limitation on the level of compensation for utilities cost, the share of expenses on them in regional households in 2016 reached 11.1%, with 70% out of them being electricity costs. In the event of full compensation of costs for the producers of electricity in the Far East either one of the following is required: the increase of population income of 1.5-2 times which is unlikely considering the limited economy growth and labor market, or considerable increase of budgetary social support which contradicts the logic of institutional changes aimed at lowering the financial burden of the state.

Introduction

Traditionally the studies of markets of heat and electricity are aimed at searching for models of their organization that allow to reliably provide energy to the consumers while minimizing the costs for producers, and at substantiating of optimal mechanisms of pricing on energy resources [1-5]. This study draws attention to the conditions of functioning and development of energy resources markets from the viewpoint of population as one of the main consumers. Taken as an object of study is the Russian Far East, traditionally the leader in energy tariffs in the country, that has an isolated energy provision. Since the country implements the state policy of transitioning to full compensation for energy services by the population [6-8], it is reasonable to consider the estimation of effective demand, taking into account the scale of consumption, the dynamics of tariffs on electricity and heat, and purchasing power of the population income.

From the viewpoint of population, demand for energy services in 2010-2016 is of most interest, when the state took active steps to implement a new economic policy in the Far East, aimed also at increasing the quality of life in the region [9].

1 Consumption of electricity and heat by the population of the Far East

Generally, the dynamics of consumption of energy by population depends on the quantity of the population, housing provision and its condition, climate, level of population income and energy resources prices [10-12].

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A bit more than 6 million people live in the Russian Far East, together occupying 145 million square meters of housing. Because of economic changes of 1990s, the constant population in the region decreased by 23.3%, while housing increased 1.5 times, which in turn allowed the housing provision to grow on average by 160% [13]. As a result of new construction, the conditions in accommodation improved; 80% of housing has central heating which is vital in the harsh climate of the Far East. The growth of housing provision together with the increase in population income, which nominally grew 30 times during the past 20 years, contribute to the growth in quality of life, expansion in the range of home appliances and equipment used, which eventually led to changes in the structure and dynamics of energy consumption.

In 2010-2016, the Far East saw, on one hand, the growth of general consumption of electricity, approximately by 3.2% annually, and on the other hand, the decrease of general consumption of heat, approximately by 1% annually. The difference in direction of dynamics is explained by the changes in the consumption of resources per capita:

- the decrease in heat consumption per capita (by 3%) happened as a result of using modern building materials and energy-saving technologies in construction, repair and modernization of residential buildings;
- the growth in electricity consumption per capita (22%) occurred thanks to the growth of income and the increase in quality of life, availability of housing and home appliances.

Despite the general trends of changing quality of life, the Far East continues to stand out with high consumption of energy thanks to the climate and geographical position: the consumption of electricity per capita is 33% higher than country average, the consumption of heat – 2.3 times higher.

Due to high demand for energy resources, the region continues to have a problem of accurate estimation of consumption volume in natural units.

Traditionally almost all housing is equipped with metering devices installed during building construction, which allows the population to control and estimate the consumption without descending lower than the vital level and having no possibility of replacing energy supplier.

In case of heat supplied to the housing through centralized heat supply systems, the population has almost no way to influence its level of consumption:

- there is either no technical way to cut off the central heating system;
- or transitioning to an alternative way of heat supply is too costly.

Besides, in harsh climate, especially in the northern territories of the Far East, shutting down the heat supply is critical from the point of view of security and preservation of integrity of life support systems. As a result, the volume of heat consumption is derived from the standards depending on the area of the premises. Thus, the population, deprived of the opportunity to control its consumption, is not interested in saving energy, as this will not decrease the payment for resources consumed [14-16].

At the same time, despite the considerable decrease in population of the Far East, it remains a stable and guaranteed consumer of energy, which is confirmed by its place in the structure of consumption in natural units. On average in 2010-2016, the share of heat consumption by the population was 63.4%, of electricity – 17.9% (compared to average in Russia – 57.5% and 14.3% respectively).

As a result, the behavior of Far Eastern population on the energy market is defined first by the specifics of energy services, the specifics of their supply and consumption in the region, and only then – by price.

2 Effective demand of population of the Far East for energy services

Effective demand of population for energy services depends on the ratio of population income and services cost [17-18]. The cost in turn is defined by the tariff and volume of consumption. Since the population is limited in opportunities for controlling the natural volume of energy consumption, the growth of tariffs inevitably leads to the increase of its payments for energy supply, which increases the burden on household budgets.

The state, while realizing large-scale projects in the Far East, attracting additional population to the region by providing comfortable living conditions, continues to regulate the utilities tariffs by limiting their growth and level of compensation.

Indeed, in 2010-2016 the tariffs for utilities in the region did not outpace the consumer price index and only grew by 53.4% compared to 70.2% national average. At the same time the increment of nominal income per capita in the Far East amounted to 75% (compared to 62.2% national average), outpacing the growth rate of utilities tariffs, which created the illusion of achieving the goal of increasing the quality of life [19].

However, energy services remain the main component of expenses on utilities, which comprise 75-80% share in the expense structure of the Far Eastern population, as opposed to 50% on average in Russia.

Despite the state attempts to contain the price growth rates, in 2010-2016 the tariffs on energy supply for the Far East exceeded those in Russia as a whole: on electricity – by 17% on average, on heat – by 65% on average. This is a continuation of high base cost of energy supply services fixed in mid-1990s in the region, that remain the highest in the country even with slower growth rates.

As a result, an average Far Easterner today can hypothetically purchase 30% less heat energy with his or her income, than on average in Russia, which shows a lower purchasing power of the population in the Far East. However, for now, the state contains the standard of compensation for utilities cost at the level of 75% of the economically justified tariff in the region on average and 40-45% - in the northern territories of the Far East.

Therefore, in case of full compensation of energy supply costs, the purchasing power of the Far Easterner decreases 2 times compared to national average. The population of the northern territories are able to purchase 3 times less heat than the population of the country as a whole.

If, taking into account current standards, the share of expenses of an average Far Easterner on utilities is 11.1% of consumer budget, than in case of full compensation only for energy producers the share may reach 15%, for the full utilities set – 20% (in northern territories – 25%). Keeping the effective demand on energy services with full tariffs at 11.1% is theoretically possible, but only when increasing the income of the Far Eastern population 1.5-2 times depending on the climate zone. Doing this is problematic since the region is objectively limited in opportunities for economic growth that could have provided the suitable level of population income, while considerable decrease in energy consumption, especially heat, is almost impossible. Thus transitioning to full compensation for energy producers will inevitably increase the burden on household budgets and will demand compensation from the state by the way of considerable subsidies.

Concluding Remarks

In order to Right now, where organization of production and provision of energy supply is concerned, the population can only control its demand in the electricity market, not in the heat market where payments are formed according to standards and using metering devices is limited due to the specifics of communal infrastructure of the housing. The demand of population for energy is price inelastic: for electricity – due to the lack of close substitutes, for heat – due to the lack of control over the consumption volume.

An important thing to point out: in case of localized economic activity and isolated energy supply systems, which are distinctive for the Far East, the decrease of demand from other groups of consumers and the growth of share of population consumption, population's burden for financially maintaining energy supply systems will increase – the systems that are already exceeding the existing demand.

Any changes in tariff policy, in case of a system of objective restrictions in growth of population income, of controlling the level of population consumption, of adequate tools of limiting the growth of unsubstantiated costs of energy producers, inevitably lead to financial costs for the state for supporting the effective demand of the population [20]. For the Far East the scale of such support is explained not

only by the high tariffs but also by higher energy consumption per capita coupled with comparatively low population income.

References

[1] Stoft S 2002 *Power System Economics: Designing Markets for Electricity*. Wiley-IEEE Press. New York.
[2] Models of Imperfect Competition Markets: Applications in the Energy Sector. In ed. V.I. Zorkal'tseva, N.I. Ayzenberg. ISEM SO RAN, Irkutsk 2015. (In Russian).
[3] Stennikov V A, Pen'kovskiy A V, Khamisov O V 2017 Searching for Cournot equilibrium in the heat energy market in conditions of competitive behavior of heat sources *Problemy upravleniya* vol. 1 pp. 10-18. (In Russian).
[4] Coming in from the Cold 2004 *Improving District Heating Policy in Transition Economies*. OECD, IEA, Paris.
[5] Dyomina O V, Minakir P A 2016 Differentiation of Electricity Prices: Role of Space and Institutions *Spatial Economics* vol. 1 pp 30-59. (In Russian).
[6] Dyomina O V 2017 The District Heating Regulation in Russia: Local Markets' Reaction *Spatial Economics* vol. 3 pp. 62-82 (In Russian).
[7] Stennikov V A 2014 "Alternative Boiler" - the Way to Nowhere for Heat Supply Novosti Teplosnabzheniya *News of Heat Supply* vol. 7 pp. 10-16. (In Russian).
[8] 'On Heat Supply' (as amended on July 29, 2017): Federal Law from 27of July 2010, No 190-FZ. (In Russian).
[9] Minakir P A 2015 New Eastern Policy and Economic Realities *Spatial Economics* vol. 2 pp. 7–11. (In Russian).
[10] Brockett D, Fridley D, Lin J, Lin J 2004 A Tale of Five Cities: The China Residential Energy Consumption Survey. *In: ACEEE Summary Study* pp. 8.29-8.40. American Council for an Energy-Efficient Economy, Pacific Grove, CA (2004).
[11] Dzioubinski O, Chipman R 1999 Trends in Consumption and Production: Household Energy Consumption *DESA Discussion* Paper. 6.
[12] *Drivers of U.S. Household Energy Consumption* 1980-2009, https://www.eia.gov/analysis/studies/buildings/households/, last accessed 2018/05/03.
[13] Motrich Ye L, Naiden S N 2015 Migratory processes in the socioeconomic development of the Far East *Studies on Russian Economic Development* vol. 26(5) pp. 491-498.
[14] Nekrasov A S, Semikashev V V 2005 Energy Expenditures in Russian Households *Studies on Russian Economic Development* vol. 6(16) pp. 592-597.
[15] Bashmakov I 2004 Readiness and Willingness of Population to Pay for Housing and Communal Services *Voprosy Ekonomiki* vol. 4 pp. 136-150. (In Russian).
[16] Nekrasov A S, Voronina S A, Semikashev V V 2012 Problems of Residential Heat Supply in Russia *Studies on Russian Economic Development* vol. 2(23) pp. 128-134.
[17] Naiden S N 2006 Solvency of the Population under Conditions of Reforming the Housing and Utilities Sector *Spatial Economics* vol. 1 pp. 44-58. (In Russian).
[18] Naiden S N 2017 Expenses of population and budgets: some results of municipal reform *Power and Administration in the East of Russia* vol. 4(81) pp. 39-48. (In Russian).
[19] Unified interdepartmental information - statistical system https://www.fedstat.ru/
[20] Agadzhanova M A 2017 The Transition to a New Model of Alternative Boiler: Analysis of Draft Normative Legal Acts *Novosti Teplosnabzheniya [News of Heat Supply]* vol. 6 pp. 8–11 (In Russian).