Journal of Optimization in Industrial Engineering
Vol.15, Issue 1, Winter & Spring 2022, 291-300
DOI: 10.22094/JOIE.2021.1945389.1912

Research Article

Development Trends and Regulation Peculiarities of the Housing and Utility Sector in Terms of the Resource Efficiency

Inna Irtyshcheva[a], Lyudmila Levkovska[b], Nazariy Popadynets[c,*], Alexei Topchiy[d], Marianna Stehnei[e]

[a] *Admiral Makarov National University of Shipbuilding, Mykolaiv,Ukraine*

[b] *Public Institution «Institute of Environmental Economics and Sustainable Development of the National Academy of Sciences of Ukraine», Kyiv, Ukraine*

[c] *Scientific-Educational Institute of Entrepreneurship and Perspective Technologies of Lviv Polytechnic National University, Lviv, Ukraine*

[d] *International University of Business and Law, Kherson, Ukraine*

[e] *Mukachevo State University, Mukachevo, Ukraine*

Received 15 September 2021; Revised 12 November 2021; Accepted 21 December 2021

Abstract

The housing and utility sector's functioning is directed at maintaining the life and work of the country's population under normal conditions as well as providing enterprises and various types of economic activity with water, gas, heat, and electricity resources. Therefore, the housing and utility sector (HUS) remains to be one of the most resource-intensive domains of economic activity. Its unprofitability undermines the attraction of investment to the development of resource-saving technology. In particular, resource losses in the housing and utility sector of Ukraine amount to 50-60%, while the level of their use is 2-3 times lower than the rates of the developed countries worldwide. The paper reveals the unsolved problems in heat supply peculiar to most settlements in Ukraine, leading to the catastrophic condition when the losses from the low energy efficiency of residential buildings are substantial. Main principles and functions of resource efficiency directed at maintenance of balance between social, environmental, and economic components of society's life are determined. The interregional asymmetries in the development of the road transport enterprises are evaluated with the calculation of standardized coefficients for the selected indicators in the transport-infrastructural and housing-utility frameworks. The need to introduce the resource-saving activities in the HUS is emphasized as the use of the capacity to reduce the cost of water, gas, heat, and electricity will increase the profitability of economic entities, thus improving their investment attractiveness for domestic and foreign investors.

Keywords: Housing and Utility Sector; Resource Efficiency; Resources; Development.

1. Introduction

Recently, the extremely quick and profound transformations of all domains of socio-economic life caused by global-scale technological innovations and socio-cultural changes have become the feature of the modern world. In turn, they started an era of the global transition to the qualitatively new global economy of the future – the sustainable development economy that is developing in harmony with nature, is inclusive, and is based on knowledge and humanitarian foundations, where an individual is the main development goal.

Emergence and introduction of a quite new concept of "smart cities" will help a person get more favorable living conditions, efficient transport, safe and clean environment. Yet the realities of the condition of domestic housing and utility sector (HUS) that is the foundation of the country residents' life support show its inability to meet the needs of current and future generations at the level that corresponds to the decent quality of life. HUS remains to be one of the most resource-intensive domains of economic activity. Its unprofitability undermines investment attraction to the development of resource-saving technology. In particular, resource losses in the housing and utility sector of Ukraine amount to 50-60%, while the level of their use is 2-3 times lower than the rates of the developed countries worldwide.

2. Analysis of Recent Research

The housing and utility sector development issues are mostly addressed indirectly because it remains in this form only in the countries of the post-Soviet space. Thus, Ie. Balatskyi, V. Lavryk (2019) analyze socio-economic parameters influencing the tariff setting for housing and utility services. In such a way, they emphasize the development of tariff policy in the housing and utility sector. S. Minakova (2015) focuses on logistic links that are the basis for the maintenance of housing and utility economy development. O. Pavlova et al. (2021) examine socio-economic differences in the development of Ukraine and Poland and pay special attention to these

*Corresponding author Email address: popadynets.n@gmail.com

issues with the condition of changing the very process of securing adequate living conditions for the population. I. Kramarenko (2020) et al. address these issues from the viewpoint of investment attractiveness of the sector and opportunities for its development. Yu. Brel (2017) outlines the problems of housing and utility sector development in Belarus, specifying the main obstacles to the development of qualitative and competitive services market. I. Drozdova and A. Petrov (2018) pay attention to the digitalization of the housing and utility sector and an opportunity to use Internet resources to improve the efficiency of business processes in the environment. Koshkalda I. et al. (2020) and Cherchata A. et al. (2020) examine in detail the development of labor capacity and its attraction into the services sector, as well as the ways to receive effect from the use of professional staff.

The lack of a comprehensive approach to the HUS research in relationship with the road transport system is an essential gap in the research of mentioned authors because the development level of the transport infrastructure strongly impacts the peculiarities of the housing and utility sector activity.

The paper aims to analyze the condition of the domestic housing and utility sector in relationship with the road transport system with the view to detect the main problems of their regulation and determine the development directions.

3. Materials and Methods

Calculation of the standardized coefficients of the selected indicators that complexly characterize the condition of the transport-logistics infrastructure and efficiency of the transport-logistics enterprises in the regions compared to the average distance between the maximum and minimum rate for Ukraine is an important stage of evaluation of interregional development asymmetries of the road transport enterprises. For this purpose, we suggest the formula of the weighted mean to conduct the complex analysis and to rank the regions by the indicators.

According to the suggested methodological approach, the process of determining the efficiency of infrastructural provision and functioning of the transport-logistics infrastructure enterprises includes the following stages:

1) Standardization of indicators:

$$N_{Pi_r} = \frac{P_{ir}}{P_{imax}} \times 100 \quad (1)$$

where N_{Pi_r} – standardized i-indicator of the road transport enterprises' development in the region that shows the level of the region's development by the indicator against the maximum rate achieved in the regions in percent;

P_{ir} - i-indicator of the road transport enterprises' development in the region;

P_{imax} - the maximum rate of the indicator achieved in the regions.

2) Calculation of the complex indicators by the directions of the infrastructural framework of the transport capacity (X) and functioning efficiency of the road transport enterprises in the region (Y) by the formula:

$$X\,(Y) = \sum N_{Pi_r} \times 0{,}25 \quad (2)$$

3) Calculation of the integral rate of the road transport enterprises' development:

$$Ir = 0.5X + 0.5Y \quad (3).$$

An opportunity to apply the suggested methodology in conditions of existing asymmetries in the territorial distribution of the coverage with transport-infrastructural and housing and utility services is the major contribution of the research.

Standardization of indicators secures the so-called 'leveling' or reduction of initial data variation, which helps to avoid consideration of random asymmetries.

The mathematical expression of formulas is based on the economic substantiation of the evaluation of the road transport enterprises functioning across two equal directions: infrastructural framework of the transport capacity (X) and functioning efficiency of the road transport enterprises in the region (Y), which explains the selection of weighting coefficients (0.5) with the total value constituting an integral unit, i.e. one.

4. Results and Discussion

Transformation processes in the domestic economy stipulate the restructuring and denationalization in various spheres, including the housing and utility sector. The launched reforms aim to financially recover the enterprises, to reduce public costs of the sector management, and to secure the consistent provision of services important for society. Active delegation of management and regulation functions to local governments by the respective enterprises and attracting the private sector to the economic domain are the peculiar features of the housing and utility sector's reforming. Nowadays, several important stages of reforming of infrastructural sectors worldwide can be allocated, including the enterprise restructuring, corporatization, establishment of public regulation, and attraction of the private sector.

It is worth mentioning that the relevance of housing and utility sector's reforming is confirmed by the results of studies carried out by the National Strategic Research Institute. In particular, the survey conducted by the Institute shows that payment of public utility costs at the new tariffs (about 43% of respondents) is the second irritant by rankings that can cause massive protests among the population of Ukraine.

According to domestic researchers, the condition of the HUS in most Ukrainian regions does not meet the interests of both consumers (services quality is low, while the tariffs are growing fast) and HUS enterprises because their crisis condition threatens to stop the productive-economic activity. Moreover, the local governments, as property owners, do not receive the proper value for its use (Lipych, Ivankiv, 2010). The situation can be improved both by enhanced public policy and attraction of economic entities into the activity of local governments and society at corresponding levels. According to other scientists, the main task of the HUS reforming is to improve the quality of services provided to consumers through the market competition of enterprises and the use

of the energy-saving technologies, to attract the investment for technological re-equipment of HUS enterprises, and to encourage the residents to create various associations to protect the consumers' rights, etc. (Halazyuk et al., 2010).

Heat supply, water supply and sewerage economy, municipal transport, and green economy are the HUS components. Despite the variety of enterprises in the sector, their fixed assets' and production capacities' depreciation is almost equally significant; their technologies are outdated, they face profit and resource losses. HUS also consumes energy substantially, and it is impossible to cover enterprises' exploitation losses at existing tariffs, etc.

According to the State Statistical Service of Ukraine, as of late 2019, the residents' arrears in the payment for natural gas supply were UAH 27.9 billion, for centralized heat and hot water supply – UAH 20.4 billion, for maintenance of buildings and outdoor territories – UAH 5.1 billion, for centralized cold water supply and sewerage – UAH 4.1 billion, for waste disposal – UAH 0.8 billion, for electricity supply – UAH 5.4 billion (State Statistics Service of Ukraine (2021)). In December 2019, the average charges for the housing and utility services, including the electricity (per 150 kWh), per one personal account holder were UAH 2212.0. According to the resolutions of the Cabinet of Ministers of Ukraine (Cabinet of Ministers of Ukraine, 1995; Cabinet of Ministers of Ukraine, 2003), in January-December 2019, 68.6 thous. agreements were concluded with the residents to cover the restructured debt for a total amount of UAH 532.5 million. The amount of made payments, including by the long-term agreements, was UAH 315.5 million.

Communal heat power sector as the component of the housing and utility sector comprises 35402 boiler houses with a total volume of heat supply in Ukraine of 89 million Gcal. On average, the largest share in the structure of the heat supply accounts for population – 66%, other utilities account for 23%, production needs – 8%, other consumers – 3%. Almost 20 % of boilers have been exploited for over 20 years, restraining the resource-saving in the entire sector.

It is worth mentioning that the condition of the energy-intensive sectors is worsening because the fixed assets are getting older in the entire energy supply system. The systems of centralized heat supply that provide almost half of the heat for industry and almost 55% for households face the urgent need for modernization and establishment of the tariff system that is based on consumption and covers full expenses. The stock of buildings is in poor condition. It stipulates the need to attract investment to modernize assets and improve the energy efficiency level. Moreover, the Law of Ukraine on the Heat Supply provides the main principles of public heat supply policy, including (Verkhovna Rada of Ukraine, 2005):

- growing energy efficiency of the heat supply systems' functioning;
- optimal combination of the systems of centralized, moderately centralized, decentralized, and autonomous heat supply;
- repeating review, improvement, and technical-economic optimization of the heat supply schemes.

However, there are unsolved problems peculiar to most settlements in Ukraine, including:

- capacity of the installed equipment of the boiler houses usually greatly exceeds the heat load;
- current regulations on management and account of the thermal energy in its production, transportation, and consumption in Ukraine are not observed;
- main and additional equipment of boiler houses has almost outlived all acceptable service lives (service lives of over 57 % of boiler houses exceed 20 years);
- poor reliability of the heat networks due to lack of their reserving, exhausted natural resources, and bad heat insulation cause the large heat losses (up to 30 %) and significant economic losses from frequent emergencies and considerable volumes of repairs;
- the centralized hot water is supplied according to the schedule in most cities, while in some cities, including the oblast centers, it is absent at all, and the pipelines of the hot water supply systems are beyond repair.

Therefore, these and other causes have generated the catastrophic condition, when the losses from the low energy efficiency of residential buildings in Ukraine are estimated at UAH 26 billion annually; about UAH 20 billion is the cost of heat dispersed because of low energy efficiency of residential buildings and about UAH 6 billion more are spent on electricity for additional heating needs. The complex modernization of an old house provides a reduction of heat losses by 60 %. The complex implementation of the thermal modernization program secures saving the consumption of natural gas in the amount of 8 billion m3 a year that accounts for 17 % of the total gas consumption in Ukraine. However, only 36% of apartment buildings in Ukraine have commercial accounting of heat consumption.

The experience of other countries shows that the first passive house in the world was built back 25 years ago in Germany. Last year the total area of passive houses in Europe surpassed 1 million m2. Currently, the largest certified passive office building is located in Vienna, its area is 21 thous. m2, while the smallest one is the house of 11 m2 in Germany. The building in German city Kaufbeuren is the first one to be certified the Passive House Premium. The building called House of Energy is one of the most efficient buildings in the world. The annual heating load of the building is only 8 kWh / m2, and the photovoltaic system on the roof covers 250 m2 (Ministry of Ecology and Natural Resources of Ukraine, 2015).

Water supply and sewerage economy is another HUS component, which supplies centralized water to 456 cities (99.3%), 775 urban settlements (87.5 %), and 6312 villages (25.2%). Most housing and utility sector's facilities (treatment facilities) had been built by 1990 on the resource base of 1970-80s technical solutions, so a considerable share of the complex's buildings has outlived themselves and require restoration. According to the State Statistical Service of Ukraine, 36.8% (18719.3

km) of sewerage networks are exhausted and damaged State (Statistics Service of Ukraine, 2021). As of early 2014, the respective length of the networks was 5270.9 km of main sewers, 8051.7 km of street sewers, 5570.6 km of the block and yard networks. Out of the total number of settlements covered by the centralized water supply, 102 settlements in 17 regions of the state receive the drinking water according to the schedule. Water supply by the schedule and its prolonged absence in the water supply networks contributes to bacterial contamination of the drinking water. The situation is much worsened by the cases of the disconnection of water supply facilities from the energy supply systems. In 261 settlements, the residents get drinking water from local sources with deviation from the regulatory requirements by the physical-chemical indicators: general hardness, chlorides, dry residues, sulfate, fluorine, total iron, nitrates, ammonia, manganese (National Institute for Strategic Studies, 2018). Therefore, the current situation in Ukraine with water supply requires the range of urgent activities to solve the tasks of both the stage-by-stage implementation of new water safety and quality indicators in compliance with EU Directives and the introduction of new resource-saving technologies in the domain (Ministry of Ecology and Natural Resources of Ukraine, 2016).

The creation of a living environment and communal services cannot be left unattended. It comprises 6.7 thous. landfills (59 million m3 of household wastes) and 32 thous. of unauthorized dumping grounds. There is a need to build new 671 landfills. 1305 economic entities provide wastes disposal services, including 379 of them in private ownership.

Municipal and inter-city transport is of similarly important role. Let's evaluate the interregional development asymmetries of the road transport infrastructure. It is reasonable to compare main parameters that characterize the level of the transport infrastructure in the regions and efficiency of transport enterprises' functioning to reveal the interregional development asymmetries of the road transport enterprises' management. For this purpose, a range of coefficients that characterize the following groups of parameters are suggested:

1) Parameters of the transport infrastructure development (X):

- density of public roads, km per thous. km2;
- share of paved roads, %;
- density of railway trucks, km per thous. km2;
- density of petrol stations, units per 10 km of roads.

Using the data of the State Statistical Service of Ukraine, the parameters of transport infrastructure level in Ukrainian regions are calculated for 2019. Table 1 shows the calculation results.

The calculation results show slight misbalances in functioning of infrastructural framework of transport and logistics sector across the regions. Lvivska oblast leads by the density of paved roads (385 km per thous. km2), Donetska – by the density of railway trucks (59 km per thous. km2 of the territory).

The density of highways in the regions of Ukraine is substantially lower than the average European rates. For example, the average highways density in Germany is 2000 km per 1 thous. km2 of the territory, France - 1460 km per 1 thous. km2 of the territory, Poland – 1150. Regarding the density of railway trucks, Ukraine also lags behind most European countries. In particular, the average density of the railway truck in Ukraine is 32 km per 1 km2 of the territory, while in Slovakia the rate is 74 km per 1 km2 of the territory, Poland – 61, Austria – 66. Naturally, the quality of road surface and organization of road network planning are much higher.

The largest concentration of petrol stations and repair shops per 10 km of roads is in Luhanska oblast, the lowest – in Zakarpatska oblast. In general, the largest gap in percent (78%) between the maximum and minimum rates of the transport-logistics infrastructure development (78%) is by concentration of petrol stations and density of railway trucks (72%).

2) Parameters of road transport enterprises' efficiency in the regions:

- volumes of carried goods per one road transport enterprise in the region, thous. tons/ units;
- cargo turnover of the road transport enterprises in the region, million tones/km.
- work efficiency of the employed in the transport-logistics system of the region determined as the volume of provided transport-logistics services per one employed in the region;
- profitability of enterprises in the transport-logistics sector of the region, %.

Table 1
Transport infrastructure development parameters across Ukrainian oblasts in 2019

Ukrainian oblasts	Roads density, km per thous. km2 (x_1)	Share of paved roads in the total length by regions (x_2)	Density of public railway trucks, km per thous. km2 of the territory (x_3)	Density of petrol stations and repair shops per 10 km of roads (x_4)
Vinnytska	358	94.3	41	3.2
Volynska	308	93.6	30	3.5
Dnipropetrovska	288	99.9	49	2.2
Donetska	305	99.2	59	3.5
Zhytomyrska	288	97.5	34	3.4
Zakarpatska	266	99.7	47	1.3
Zaporizka	258	97.6	36	2.2
Ivano-Frankivska	295	100	36	2.3
Kyivska	309	99.8	28	1.8

Kirovohradska	256	98.5	36	3.2
Luhanska	165	99.2	41	6.2
Lvivska	385	97.9	58	2.2
Mykolayivska	195	99.7	29	1.9
Odeska	249	97.3	31	1.9
Poltavska	310	99.9	30	3.0
Rivnenska	259	98.6	29	3.0
Sumska	302	93.1	30	4.6
Ternopilska	362	99.5	41	2.6
Harkivska	309	97.5	48	2.0
Hersonska	176	99.3	16	2.3
Hmelnytska	349	99.3	36	3.3
Cherkaska	292	97.2	28	2.4
Chernivetska	358	99.8	51	1.7
Chernihivska	242	93.7	27	3.8

Source: State Statistics Service of Ukraine (2021).

The efficiency of the road transport enterprises' operation in the regions is calculated based on the data of the State Statistical Service of Ukraine. Table 2 provides the results of calculations.

Table 2
Parameters of road transport enterprises' efficiency in Ukrainian regions in 2019

Ukrainian oblasts	Productivity of the road transport enterprises, thous. t./units (y_1)	Cargo turnover of the road transport enterprises, thous. t./km (y_2)	Labor productivity in the sector, thous. UAH (y_3)	Profitability of business operations of the road transport enterprises, %, (y_4)
Vinnytska	8.9	512.5	3488.8	5.5
Volynska	8.7	1075.0	7578.6	6.2
Dnipropetrovska	8.0	1891.3	10163.0	7.8
Donetska	14.8	279.2	6839.8	3.8
Zhytomyrska	16.7	391.6	2317.9	-2.5
Zakarpatska	2.5	917.4	2016.4	1.9
Zaporizka	4.4	620.5	7768.0	3.2
Ivano-Frankivska	10.5	701.2	3427.3	0.1
Kyivska	3.0	1320.4	6427.1	14.8
Kirovohradska	38.2	727.5	3430.4	3.4
Luhanska	0.5	107.4	2318.1	0.3
Lvivska	7.6	2657.7	4137.3	3.1
Mykolayivska	4.0	691.8	4483.6	18.6
Odeska	2.1	1691.3	3123.8	13.3
Poltavska	3.3	683.0	7008.4	4.7
Rivnenska	3.2	1012.3	2337.2	6.3
Sumska	2.6	213.7	3221.7	0.4
Ternopilska	14.3	525.8	3005.2	1.7
Harkivska	7.9	2377.3	4593.2	0.7
Hersonska	2.9	364.6	2882.1	-0.5
Hmelnytska	12.7	656.2	3653.7	4.6
Cherkaska	4.8	376.7	5178.5	2.5
Chernivetska	4.3	255.4	1680.9	-0.9
Chernihivska	1.5	526.9	4894.6	4.3

Source: calculated by the authors (State Statistics Service of Ukraine, 2021).

The analysis shows significant interregional asymmetries of the road transport sector development in Ukraine. In particular, the distance between the maximum and minimum rates across regions is over 90%. Kirovohradska oblast is among the leaders by the productivity level of the road transport enterprises (38.2 thous.t per road transport enterprise). However, the rate is caused in the first place by the fewer enterprises in the sector compared to the other regions. Luhanska oblast has the lowest profitability and cargo turnover rates due to in the first place the occupation of a part of its territory and, on the other hand, the disruption of intersectoral and trade relations with Russia.

Regarding the efficiency of the road transport enterprises, the most profitable are the enterprises in Mykolayivska (18%), Kyivska (14%), and Odeska (13%) oblasts due to high business activity rates caused by important transport hubs and cargo turnover above average in Ukraine. In some regions, including Zhytomyrska, Hersonska, and Chernivetska oblasts, the operation profitability of the

road transport enterprises was negative.

Based on the suggested methodology and data in Tables 1, 2, the standardized and complex parameters of infrastructural framework of the transport-logistic activity in Ukrainian regions that show the level the infrastructure condition corresponds to the reference value in percent are calculated. Table 3 shows the calculation results.

Table 3
Standardized and complex parameters of infrastructural framework of road transport enterprises' activity in Ukrainian regions

Oblasts	x_1	x_2	x_3	x_4	X
Vinnytska	93.0	94.3	69.5	51.6	**77.1**
Volynska	80.0	93.6	50.8	56.5	**70.2**
Dnipropetrovska	74.8	99.9	83.1	35.5	**73.3**
Donetska	79.2	99.2	100.0	56.5	**83.7**
Zhytomyrska	74.8	97.5	57.6	54.8	**71.2**
Zakarpatska	69.1	99.7	79.7	21.0	**67.4**
Zaporizka	67.0	97.6	61.0	35.5	**65.3**
Ivano-Frankivska	76.6	100.0	61.0	37.1	**68.7**
Kyivska	80.3	99.8	47.5	29.0	**64.1**
Kirovohradska	66.5	98.5	61.0	51.6	**69.4**
Luhanska	42.9	99.2	69.5	100.0	**77.9**
Lvivska	100.0	97.9	98.3	35.5	**82.9**
Mykolayivska	50.6	99.7	49.2	30.6	**57.5**
Odeska	64.7	97.3	52.5	30.6	**61.3**
Poltavska	80.5	99.9	50.8	48.4	**69.9**
Rivnenska	67.3	98.6	49.2	48.4	**65.9**
Sumska	78.4	93.1	50.8	74.2	**74.1**
Ternopilska	94.0	99.5	69.5	41.9	**76.2**
Harkivska	80.3	97.5	81.4	32.3	**72.8**
Hersonska	45.7	99.3	27.1	37.1	**52.3**
Hmelnytska	90.6	99.3	61.0	53.2	**76.0**
Cherkaska	75.8	97.2	47.5	38.7	**64.8**
Chernivetska	93.0	99.8	86.4	27.4	**76.7**
Chernihivska	62.9	93.7	45.8	61.3	**65.9**

Source: calculated by the authors (State Statistics Service of Ukraine, 2021).

The results of calculations show slight deviations of the complex parameter of the road transport enterprises' infrastructural framework from the reference value. The weighted parameters are the closest to the reference (over 80%) in Lvivska and Donetska oblasts. The complex deviation in the other regions is 60-70%, excluding Hersonska oblast (52%). Therefore, despite the asymmetries of single indicators' territorial distribution, the complex parameters of infrastructural framework do not show substantial asymmetries due to existing advantages in the regions.

Based on the data in the Table, the standardized and complex parameters of road transport enterprises' functioning efficiency in Ukrainian regions are calculated. Table 4 shows the calculation results.

The results of calculations show significant asymmetries of the road transport enterprises' regional development in the context of efficiency and profitability of their functioning. Despite the high values of some single indicators, the complex rate of the efficiency of the transport-logistic enterprises' development is quite low and shows significant interregional asymmetries. In 2018, the highest rates (40-58%) were observed in Dnipropetrovska, Kyivska, Odeska, Mykolayivska, and Harkivska oblasts, i.e. in the regions with a high concentration of important transport hubs and well developed various means of transport.

Therefore, the parameters of operation efficiency of the road transport enterprises depend on external and internal factors. The external factors include in the first place the enterprise's location regarding the perspective consumers, condition of transport infrastructure, and economic development level in a country. The internal factors comprise in the first place the efficiency of functions of planning, organization of services, employees' motivation, and control. That is why the improvement of functions and structures of logistic management at domestic enterprises is one of the important tasks to be accomplished to improve the profitability of the transport-logistic sector and its competitiveness at international transportation market.

Taking into account the European integration aspirations of Ukraine, it is worth mentioning that the implementation of EU legal provisions on environmental protection (recorded in directives and regulations) deriving from the EU-Ukraine Association Agreement requires the solution of important tasks on prevention of waste generation, promotion of its recycling and recovery to reduce their impact on the environment. The EU legislation on waste management (and its certain types) consists of over 10 directives. The list of the Association Agreement includes three of them: Waste (Framework) Directive; Directive on the Landfill of Waste; and Directive on the Management of Waste from Extractive Industries. Transforming the wastes into resources and reducing the volumes of their generation are the priority goals hereto, while the priority

goals of wastes management will secure the movement towards a circular economy with the cascade use of resources and minimized volumes of residual products. In the meantime, the management of wastes and resources transforms into the interconnected block of issues (Ministry of Ecology and Natural Resources of Ukraine, 2013).

Table 4
Standardized and complex parameters of the road transport enterprises' functioning efficiency in Ukrainian regions

Oblasts	x_1	x_2	x_3	x_4	X
Vinnytska	23.30	19.28	34.33	29.57	26.62
Volynska	22.77	40.45	74.57	33.33	42.78
Dnipropetrovska	20.94	71.16	100.00	41.94	58.51
Donetska	38.74	10.51	67.30	20.43	34.24
Zhytomyrska	43.72	14.73	22.81	-13.44	16.95
Zakarpatska	6.54	34.52	19.84	10.22	17.78
Zaporizka	11.52	23.35	76.43	17.20	32.13
Ivano-Frankivska	27.49	26.38	33.72	0.54	22.03
Kyivska	7.85	49.68	63.24	79.57	50.09
Kirovohradska	100.00	27.37	33.75	18.28	44.85
Luhanska	1.31	4.04	22.81	1.61	7.44
Lvivska	19.90	100.00	40.71	16.67	44.32
Mykolayivska	10.47	26.03	44.12	100.00	45.15
Odeska	5.50	63.64	30.74	71.51	42.84
Poltavska	8.64	25.70	68.96	25.27	32.14
Rivnenska	8.38	38.09	23.00	33.87	25.83
Sumska	6.81	8.04	31.70	2.15	12.17
Ternopilska	37.43	19.78	29.57	9.14	23.98
Harkivska	20.68	89.45	45.20	3.76	49.77
Hersonska	7.59	13.72	28.36	-2.69	11.75
Hmelnytska	33.25	24.69	35.95	24.73	29.65
Cherkaska	12.57	14.17	50.95	13.44	22.78
Chernivetska	11.26	9.61	16.54	-4.84	8.14
Chernihivska	3.93	19.83	48.16	23.12	23.76

Source: calculated by the authors (State Statistics Service of Ukraine, 2021).

Therefore, the resource-saving is the perspective direction of economic development, because it secures the balance of social, environmental, and economic components of the society's vital activity. According to scientists, the resource-saving is the organizational, economic, scientific-technological, practical, and informational activity that accompanies all stages of the life cycle of objects and is directed at securing the minimum losses of a material and energy per a unit of the final product, taking into account the existing level of technology development and the least impact on people and natural systems (Melnyk et al., 2010). The activity should be based on corresponding principles and secure accomplishment of the defined functions (Fig. 1). In terms of the HUS, the smart city concept deserves special attention because it provides that the city uses various information technologies for more efficient functioning and meeting the needs of its citizens (Halapup, 2019).

It is worth mentioning that the housing and utility reform is one of the complementary reforms conducted in the course of decentralization in Ukraine. In early 2019, a new decentralization reform stage initiated by the Cabinet of Ministers of Ukraine started. It stipulates the anchoring of already achieved success and finalization of forming of capable communities, change of territorial structure, clear delineation of competences and control functions at various management levels, and development of local democracy forms (Cabinet of Ministers of Ukraine, 2019). The new decentralization reform stage includes forming of 100 capable districts and 1600-1800 capable communities, which should result in the forming of an efficient management system and strengthening of the financial self-sufficiency of local governments.

The solution of HUS funding problems is related to forming of decentralized approaches directed at improvement of the sector's investment attractiveness for both domestic and foreign investors, development of public-private and municipal-private partnership forms, forming of the municipal banks' network, activation of cooperation with international financial organizations, improvement of the mechanisms of funds attraction to the priority directions of the HUS development (Irtyshcheva et al. 2019).

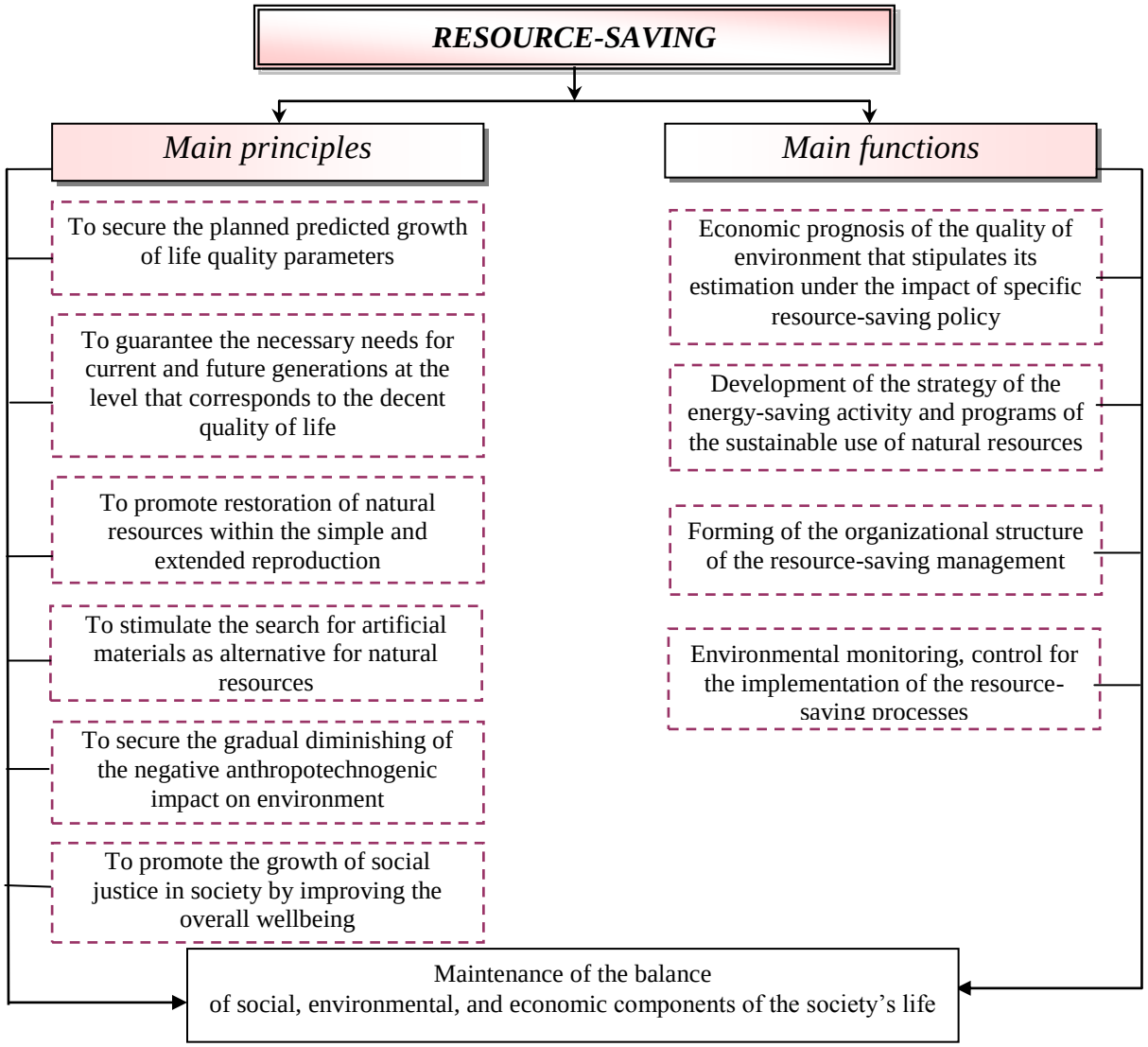

Fig. 1. Principles and functions of maintaining the balance of social, environmental, and economic components of the society's life. *Source: Author's own*

5. Conclusion

Financial decentralization will contribute to the solution of financial problems of the HUS reforming in the established consolidated territorial communities for the benefit of their residents. Due to transferring additional tax and non-tax sources to the local level, the budgets' own revenues have increased by 165.5 billion UAH (from 68.6 to 234.1 billion UAH). Moreover, the successful development of consolidated territorial communities is also supported by the State Regional Development Fund. Its funds had increased more than twice from 2016 to 2019, i.e. from 2.9 billion UAH to 6 billion UAH. Such public financial support will promote the implementation of investment programs and projects in securing the HUS development in territorial communities.

The suggested methodology of evaluating the interregional asymmetries in the development of the road transport enterprises can be applied in the system of the management of the transport-infrastructural and housing-utility frameworks at the level of regions or territories. Determining and calculating the advantages of regions by evaluating the interregional asymmetries contributes to the identification of strengths and weaknesses of each region and possible identification of external and internal factors of infrastructural-logical and housing-utility management.

Therefore, summing up all the abovementioned, it is worth mentioning that housing and utility sector and transport-infrastructural economy constitute an important life-supporting domain that is meant to secure decent life and labor conditions for the country's population and provide enterprises and organizations with necessary water, gas, electricity, and heat resources to successfully perform their functioning and development tasks. High hopes are focused on the National Commission performing the public regulation in energy and utility sectors, which should coordinate all programs on reduction of resource losses at the HUS facilities, energy saving, and irrational costs rather than solve methodological issues of development of economically grounded tariffs. The use of the capacity of reducing cost of water, gas, heat, electricity will boost the profitability

of economic entities, which, in turn, will improve their investment attractiveness for domestic and foreign investors.

References

Balatskyi, Ie., Lavryk, V. (2019). Defining the tariff burden when providing the housing and utilities services in Ukraine. *Public and Municipal Finance*, 8(1), pp. 112-119. doi:10.21511/pmf.08(1).2019.10

Brel, Yu. (2017). The Utilities and Housing Sector Crisis in the Republic of Belarus. *Journal of Public Administration*, 52(1), pp. 52-63.

Cabinet of Ministers of Ukraine (1995). On simplification of the procedure of granting subsidies to population to reimburse the housing and utility payments and purchase of the liquid gas and solid and liquid heating household oil. 21 October, № 848. Available at: https://zakon.rada.gov.ua/laws/show/848-95-%D0%BF#Text

Cabinet of Ministers of Ukraine (2003). On approval of the Procedure of the restructured debt repayment and current housing and utility payments. 27 June, №976. Available at: https://zakon.rada.gov.ua/laws/show/976-2003-%D0%BF#Text

Cabinet of Ministers of Ukraine (2019). On approval of the action plan on implementation of a new stage of local governance and authorities' territorial organization reforming in Ukraine in 2019-2021. 23 January, №77-r. Available at: https://zakon.rada.gov.ua/laws/show/77-2019-%D1%80

Cherchata, A., Popovychenko, I., Andrusiv, U., Simkiv, L., Kliukha, O., Horai, O. (2020). A methodology for analysis and assessment of business processes of Ukrainian enterprises. Management Science Letters , 10(3), pp. 631-640. doi: 10.5267/j.msl.2019.9.016

Drozdova, I., Petrov, A. (2018). World practice and Russian experience of housing and utilities sector digitization. *SHS Web of Conferences* 44, 00031 https://doi.org/10.1051/shsconf/20184400031 CC-TESC2018

Halazyuk, N. M., Ivanochko, S. S., Kipershtain, A. A. (2010). Problems of housing and utility sector's development in Ukraine and main directions of their elimination. *Scientific bulletin NDTU. Series "Sector economy, planning, and management",* 20(6), pp. 157-163.

Halapup, L.O. (2019). Forming of the mechanism of sustainable development of the urban transport system based on the "smart city" concept. *Eastern Europe: economy, business, and management*, 3(20), pp. 65-69.

Irtyshcheva, I.O., Stehney, M.I., Topchiy, O.O. (2019). Problems and perspectives of the HUS development in Ukraine: financial aspect. *Bulletin of HNAU named after V.V. Dokuchayev. Series "Economic sciences"*, 2, pp. 353-365.

Koshkalda, I., Kniaz, O., Ryasnyanska, A., Velieva, V. (2020). Motivation Mechanism for Stimulating the Labor Potential. Research in World Economythis link is disabled, 11(4), pp. 53–61.

Kramarenko, I., Irtyshcheva, I., Shults, S., Boiko, Y., Blishchuk, K., Hryshyna, N., Popadynets, N., Dubynska, I., Ishchenko, O., Krapyvina, D. (2020). Building favorable investment climate for economic development. *Accounting*, 6(5), pp. 773–780. doi: 10.5267/j.ac.2020.6.006

Lipych, L. H., Ivankiv, O. Y. (2010). Some aspects of housing and utility sector's reforming. *Sustainable economic development. Series: Economy and national economy management*, 3, pp. 7-10.

Melnyk, L.H., Sotnyk, I.M., Chyhyryn, O.Y. (2010). Economy of natural resources: handbook. Sumy: Universytetska knyha.

Minakova, S.M., Irtyshcheva, I.O. (2015). Types, purposes and formation process of the program of changes in logistics system. *Actual Problems of Economics*, 165(3), pp. 155–160.

Ministry of Ecology and Natural Resources of Ukraine (2013). Institutional development of wastes management in Ukraine: towards European integration: European Union Project "Complementary Support to the Ministry of Ecology and Natural Resources of Ukraine for the Sector Budget Support Implementation". Available at: http://ecos.kiev.ua/share/upload/mono_29.pdf

Ministry of Ecology and Natural Resources of Ukraine (2015). EU technical assistance project "Complementary Support to the Ministry of Ecology and Natural Resources of Ukraine for the Sector Budget Support Implementation". Available at: http://www.geo.univ.kiev.ua/images/doc_file/Water_glossary_.pdf

Ministry of Ecology and Natural Resources of Ukraine (2016). Indicative value evaluation of Ukrainian legislation's approximation to the EU environmental legislation and policy. European Union project "Complementary Support to the Ministry of Ecology and Natural Resources of Ukraine for the Sector Budget Support Implementation". Available at: https://menr.gov.ua/timeline/?t=553&th=553&m=6&g=0&from=&till=

National Institute for Strategic Studies (2018). Maintenance of the cities' sustainable development as a component of socio-economic modernization of Ukrainian regions. Available at: http://old2.niss.gov.ua/articles/1611/

Pavlova, O., Pavlov, K., Novosad, O., Irtyshcheva, I., Popadynets, N., Hryhoruk, I., Gelich, N., Suriak, A., Makara, O., Zhuk, O., Boiko, Y., Kramarenko, I. (2021). Strategic Priorities for Socio-economic Development of Ukraine in Comparison with the

Republic of Poland. In: Karwowski W., Ahram T., Etinger D., Tanković N., Taiar R. (eds) Human Systems Engineering and Design III. IHSED 2020. Advances in Intelligent Systems and Computing, vol 1269. Springer, Cham. https://doi.org/10.1007/978-3-030-58282-1_49

State Statistics Service of Ukraine (2021). Official website. Available at: http://www.ukrstat.gov.ua/

Verkhovna Rada of Ukraine (2005). On heat supply: Law of Ukraine, № 28. Available at: https://zakon.rada.gov.ua/laws/show/2633-15.

This article can be cited:
Popadynets, N., Irtyshcheva, I., Levkovska, L., Topchiy, A., Stehnei, M. (2022). Development Trends and Regualtion Peculiarities of the Housing and Utility Sector in Terms of the Resource Efficiency. *Journal of Optimization in Industrial Engineering*, 15(1), 291-300.

http://www.qjie.ir/article_687282.html
DOI: 10.22094/joie.2021.1945389.1912

МУКАЧІВСЬКИЙ ДЕРЖАВНИЙ УНІВЕРСИТЕТ

89600, м. Мукачево, вул. Ужгородська, 26
тел./факс +380-3131-21109
Веб-сайт університету: www.msu.edu.ua
E-mail: info@msu.edu.ua, pr@mail.msu.edu.ua
Веб-сайт Інституційного репозитарію Наукової бібліотеки МДУ: http://dspace.msu.edu.ua:8080
Веб-сайт Наукової бібліотеки МДУ: http://msu.edu.ua/library/