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Social issues of sustainable energy development in Lithuania

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Energy is central in achieving the interrelated economic, social and environmental aims of sustainable human development. Energy production and use are the major factors for economic and social development as well as for general standards of living.

The aim of the article is to analyse social problems related to energy (energy disparities, energy accessibility and affordability in Lithuania) and to relate them with the sustainable development goals set for Lithuania. The main trends of energy consumption, GDP growth and energy affordability indicators were studied, their interrelations were analysed and conclusions were drawn seeking to implement social dimension targets of sustainable energy development.

Key words: energy affordability, energy disparities, living standards

1. INTRODUCTION

Global Sustainable Development Action Programme, Rio Declaration on Environment and Development and Johannesburg Summit Declaration emphasise that energy production is the major factor for economic and social development as well as for general standards of living.

At present, all over the world the production and consumption of energy is mostly based on non-sustainable technologies which will not be tolerated in future. The future growth of energy demand will make it impossible to rely on the present technologies and exhaustible energy resources. The economic growth allows to develop and implement more advanced energy-efficient technologies, to increase the use of renewables and other non-traditional energy resources. This interrelation between the national income per person and the concentration level of industrial waste is called the environmental Kuznets curve (Fig. 1), analogous to the traditional curve proposed by Simon Kuznets, which demonstrates a similar relationship between actual income per person and income inequality. This relationship proves that economic, ecological of sustainable development can be achieved together by implementing an effective policy of sustainable development management.

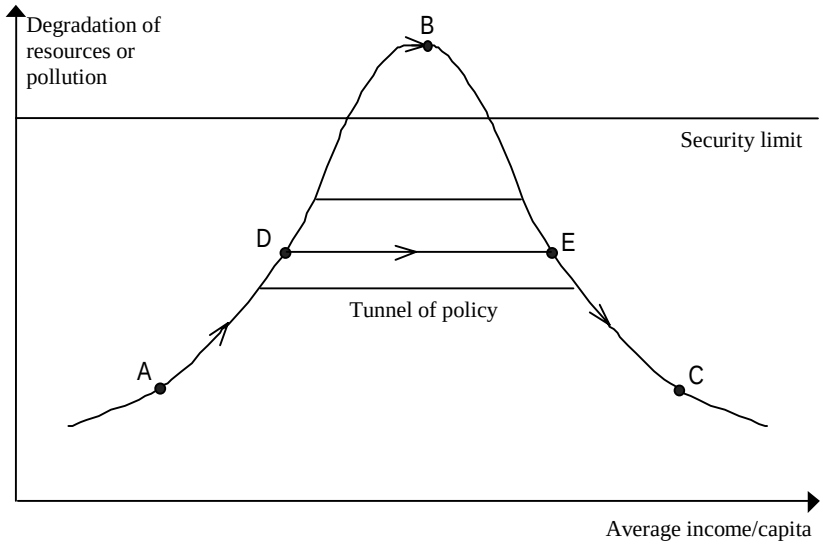

Fig. 1. Relationship between environmental quality and income per capita level

The Kuznets curve indicates that with an increase of GDP energy consumption and pollution are growing, but at a certain stage of growth the trends of energy

consumption and pollution should change. Some data on environmental quality (environmental resource utilisation) and indicators of income per capita allow to make an assumption that environmental quality is going down when income per capita is at a low level. However with an increase of income the environmental pressure starts to decouple from the economic growth.

Some environmental economists have proposed to developing countries to learn the experience of developed countries and to blaze the trail in the Kuznets curve using environmental policy measures and not to follow the development track of rich countries seeking to avoid the environmental degradation pike [1, 2].

There are no clear explanations of the reasons for a decrease of environmental pollution at a certain level of GDP per capita. This relationship between natural resource degradation and GDP per capita highly depends upon the technological effects, their degree and composition [3].

The demand of industrialised countries and transition economies for energy services is likely to grow, although the increasing efficiency in conversion and end uses may result in a levelling off or even reduction in the demand for primary energy. In developing countries, however, primary energy demand is expected to grow at about 2.5 percent a year as industrialisation and motorisation proceed and living standards improve.

Energy is central in achieving the interrelated economic, social and environmental aims of sustainable human development. Energy production and use are the major factors for economic and social development as well as for general standards of living.

The aim of the current work was is to analyse the social problems related to energy, such as energy disparities, energy accessibility and affordability in Lithuania, and to relate them with sustainable energy development goals for Lithuania.

The main targets of the paper are:

– to analyse energy consumption and GDP growth trends in Lithuania and EU-15;

– to analyse energy prices and income level in Lithuania and EU-15 countries;

– to analyse energy affordability indicators in Lithuania and EU-15;

– to make conclusions on policy measures necessary to improve the situation.

The methods applied: policy analysis and synthesis, comparison and generalisation.

2. ENERGY CONSUMPTION AND GDP PER CAPITA GROWTH TRENDS

A considerable amount of research has been done on convergence of *per capita* income between the poorer and richer countries of the world. Economies are assumed to be converging toward one another if the income of poorer economies grows faster over time relative to that of the richer economies, thus reducing inter-country income inequality. X. Sala-i Martin [4] studied and compared the speeds of income convergence across various datasets, which included a sub-sample of OECD countries, states within the United States, prefectures of Japan, and regions within several European countries. Across the datasets, the speed of convergence was found to be similar (about 2% per annum). V. Kaitila [5] studied income convergence among two groups of countries (15 EU countries and 7 CEEC countries) and found the rate of convergence for each of the two groups to be approximately 0.02% and 0.03%, respectively. Other literatures [6–8] extended their analysis of income growth to include other elements besides income, *e.g.*, employment, labor productivity, technological diffusion and exchange rate volatility. For 15 EU member countries, K. Bunyaratavej and E. Hahn [6] found an income convergence rate of 1.6%, while Wagner and Hlouskova [7] examined 14 EU countries (without Luxembourg) and found

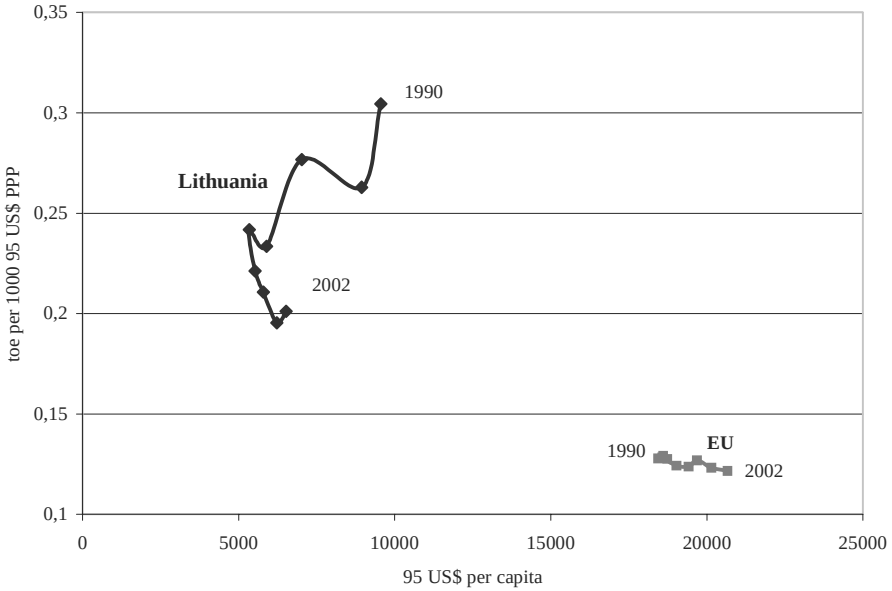

Fig. 2. Final energy intensity and GDP per capita in Lithuania as compared to with EU-15

the speed of convergence to be between 0.01% to 0.02%. On the other hand, A. Dela Fuente [8] found 0.03% for the OECD countries.

In Fig. 2 the relationship between final energy intensity [9] and GDP per capita in Lithuania [10] and EU-15 is presented. The figure suggests that the trends for Lithuania are not very favourable, because with the slow increase of GDP per capita the energy intensity of economy is decreasing steadily. As one can see from Fig. 2, the final energy intensity is very high and final energy consumption is very low in Lithuania comparing with the same indicators of EU-15 countries. In EU-15 countries energy intensity is slightly decreasing with an increase of GDP per capita. In Lithuania, final energy intensity was decreasing with a decrease of energy consumption per capita, however since 2000 new trends of final energy consumption per capita increase can be noticed.

The same trends can be noticed by analysing relationship between final energy consumption per capita and final energy intensity. In Lithuania final energy intensity is decreasing and final energy consumption per capita stated to increase since 2000. In EU-15 final energy intensity is decreasing with slow increase of final energy consumption per capita.

As real incomes converge between the EU-15 and the new member states, one might expect energy intensity also to converge. The case for such convergence, however, has not been made. The relationship between GDP and Total Primary Energy Supply (TPES) is found to be broadly log-linear, with an elasticity of TPES with respect to GDP of 0.75 in developed countries and one for developing countries (the average across all countries is 0.85). These results are from WEC [11] and are based on data from 1982. The significant differences between developing and developed market economies have two origins: (a) the transformation of some unaccounted non-commercial energy into commercial energy when the economy grows, and (b) the relocation of some industries, because the economic inputs, mostly labour and energy, are cheaper in the developing than in the developed countries. Most importantly, however, with these elasticities, even if there is convergence in real *per capita* income, there will not be convergence in energy intensities.

Why is the evolution of energy intensity important? First, it is useful for energy policy makers to know how energy demand will grow, in the face of major changes in economic structure and the system of economic management. Traditional energy demand forecasting models, while useful, find it difficult to incorporate such structural changes. Second, there is an active policy debate within the transition countries themselves as to whether total energy use should grow as GDP grows. Presently these countries have a lower level of energy efficiency (higher intensity) than the EU-15. If convergence is fast enough, and if growth is modest, there may be no increase in total energy use. In that case a target of non-increasing energy may be feasible and desirable as part of a sustainability strategy. If, on the other hand, convergence is slow and growth rapid, it will not be feasible to set a target of this kind. Analysis using econometric models showed [12] that over the period to 2020 we can expect energy intensities of new EU member states to converge to EU levels significantly for six of the seven countries – *i.e.* all except Estonia. Analysis of the actual level of energy demand in each of the new member states showed that between 2000 and 2020 energy demand will increase in all 7 countries in spite of the major decline in energy intensity. Thus, it will not be feasible to use as a target a non-increasing level of total energy consumption.

Table 1. **Electricity, heat and natural gas prices for households in Lithuania and EU-15**

Energy sources	1992	1993	1994	1995	1996	1997	1998	1999	2000
Electricity, USD/kWh									
Lithuania	0.001	0.014	0.02	0.04	0.05	0.05	0.047	0.047	0.058
EU	0.1221	0.1232	0.127	0.1311	0.1305	0.128	0.1289	0.1284	0.1303
District heat, USD/GJ									
Lithuania	0.36	2.7	14.4	33.3	64.8	80.1	94.5	97.2	103.5
EU	99.7	102.2	104.4	110.2	110.9	115.2	117.7	118.8	121
Natural gas, USD/GJ									
Lithuania	0.099	2.2	3.6	4.8	5.7	5.8	5.6	5.6	8.8
EU	15.8	15.2	15.7	16.1	15.9	16.6	17.4	17.2	17.4

3. ENERGY PRICES

The above analysis indicates that GDP/capita and energy consumption per capita are very low and show the low living standards in Lithuania. Final energy consumption per capita in Lithuania is 2 times (electricity per capita more than 3 times) lower than in the EU-15. As GDP/capita was increasing in Lithuania, electricity and final energy per capita was decreasing up to 2000. This can be related with high energy prices in Lithuania, especially for district heat. The dynamics of electricity,

heat and natural gas prices for households in Lithuania and EU-15 without taxes is presented in Table 1.

From 1993 to 1997 electricity, gas and district heating tariffs have risen drastically in line with overall Government policies so as to, as a minimum, recover production costs. The higher prices have an impact on energy demand but also on the ability of consumers to pay the increased rates.

As one can see from Table 1, the electricity prices in Lithuania are more than two times lower than the EU average. In the EU, electricity prices for households were almost stable for several years. In Lithuania, electricity prices for households are slightly increasing. Natural gas prices are also 2 times higher in the EU-15 than in Lithuania. Only district heat prices in Lithuania are very close to those of the EU-15. Taking into consideration that GDP/capita adjusted at PPP in Lithuania is almost 3 times lower than in the EU-15, one can notice that such high district heat prices is a hard burden for Lithuanian households.

Seeking to protect the low-income population, on 15 September 1993 the Government introduced the first system for income support to cover heating costs. This system limited payments for heat to 20% of family's monthly income. This system was being modified during the previous years, and in May 1999 a similar system was adopted only limits were increased up to 25% and the share of expenditures for cold and hot water started to be limited as well. Expenditures for cold water exceeding 2% of household income and for hot water 5% of income are paid by the municipalities. According to official statistics, in 2000 these support schemes were applied to 6–7% of population in Lithuania.

4. SOCIAL WELFARE

The main economic index of social welfare is GDP per capita expressed in PPP. From 1990 to 1994 this index was decreasing in Lithuania. Since 1995 it began to grow, but in 1999 because of the economic crisis in Russia dropped. Since 2000 the positive trends of GDP/capita increase can be noticed in Lithuania. At present, in the EU-15 this index is almost 3 times higher and is continuously increasing (Fig. 3).

The poverty level is expressed in the national poverty level (the percentage of the population that is below the national poverty line and the population that is below the region's extreme poverty level of 2.15 USD in PPP per day). The poverty gap ratio (incidence × depth of poverty) and the share of poorest quantile in national consumption are recognized as good poverty indicators. The poverty gap ratio is an indicator that shows the average gap between the poverty line and the mean expenditure of the poor expressed as a ratio of the poverty line. In Lithuania this indicator makes about 23% [13].

The national or relative poverty level is the proportion of the population in the country, which has expenditures below the poverty line. The poverty line equals to 50% of mean consumption expenditures per month (260 Litas or 65 USD in 2000). Average consumption expenditures are calculated using the equivalent scale of OECD: the first adult household member is equated to 1, each next adult to 0.7 and each child under 14 to 0.5 [13].

The poverty level in Lithuania started to be recorded and reported since 1996. It was decreasing up to 1999 and then started to increase because of the impact of the economic crisis in Russia. Since 2001 the positive trends in poverty level decrease can be noted in Lithuania.

According to World Bank data [15], the poverty level in Lithuania by applying international poverty indicator (2.15 USD/day) was 3.1% in 1999. However, it is doubtful that this indicator is correct, because the national poverty line reported in that year

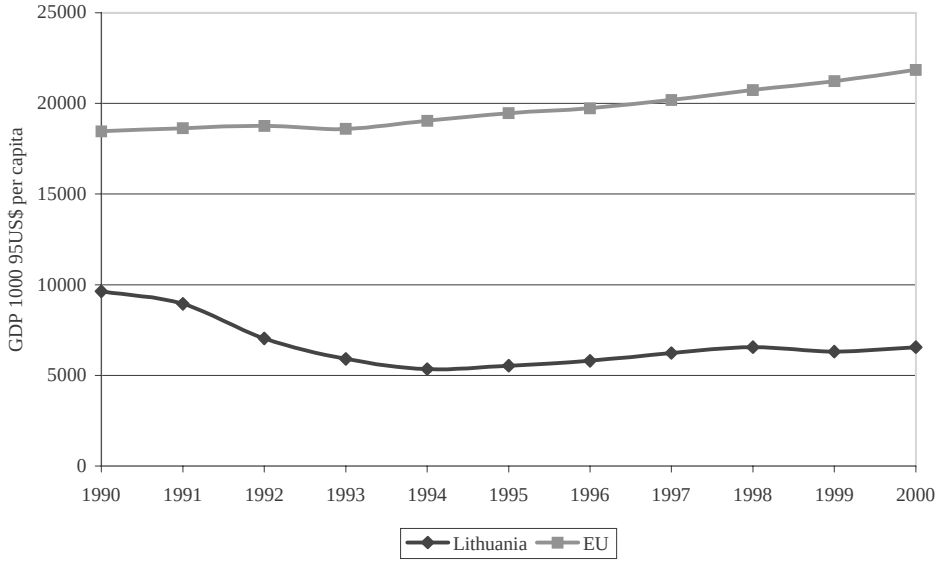

Fig. 3. GDP/capita in Lithuania and EU-15

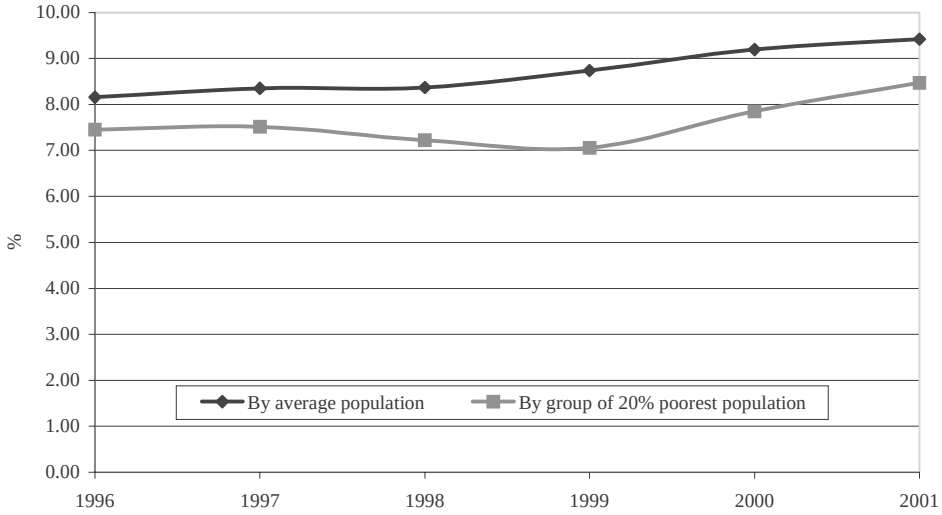

Fig. 4. The fraction of disposable expenditures spent on household fuel and electricity as a percentage of total private consumption per capita by average population and by group of 20% poorest population

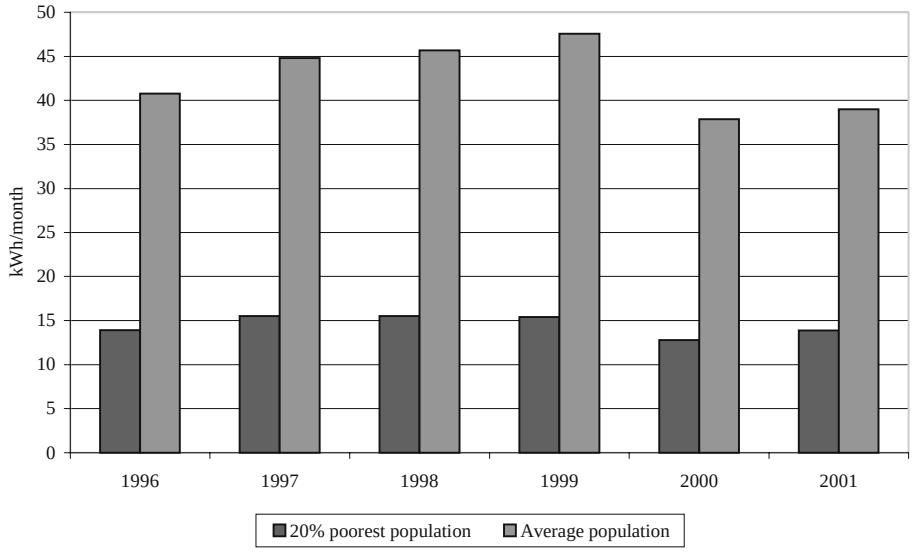

Fig. 5. The ratio of monthly disposable income per capita of 20% of poorest and average population to the prices of electricity

amounted to 274.6 Lt per month or 2.3 USD/day and the poverty level reported reached 15.8%, so the poverty level in Lithuania according to the region's extreme poverty level should have been significantly higher.

Thus, we can conclude that poverty, income inequality and low living standards are serious problems in Lithuania. Further we shall analyse the trends of social dimension indicators from the ISED list.

5. ENERGY AFFORDABILITY

Energy affordability can be measured by income inequality, the fraction of disposable income/private consumption spent on energy, the ratio of daily disposable income per capita of 20% of poorest population to the prices of energy.

Income inequality is the ratio of disposable income or private consumption in terms of individual available to the groups of poorest 20% and richest 20% of the population. This indicator, like the Gini index, is relevant to the equity component of sustainable development and describes the difference of expenditures of an inhabitant in the population. The Gini index is always between 0 and 1. The bigger it is, the bigger the economic inequality in the society. The Gini index is being reported since 1996 in Lithuania. Since 2000, positive trends in the Gini index decrease could be noted in Lithuania. Currently the Gini index in Lithuania makes about 0.33 (in Finland about 0.22) [15].

Another important energy affordability indicator, the fraction of disposable income/private consumption spent on fuel and electricity, shows the expenditures spent for household fuel and electricity as a percentage of total private consumption per capita by average population and by the group of 20% of poorest population. This indicator provides a measure of energy affordability by average population and by poorest household, indicating income inequality as well. This indicator is supplementary to such general indicator of welfare as GDP/capita, because income distribution in the country can vary very widely. Low income population can have no possibility to meet their full needs in commercial energy at the current price and income levels.

In Lithuania, official statistics provide this information since 1996, but data sources report the share of average household consumption expenditures on electricity, fuel, water and housing. The data are given for deciles. Deciles are calculated

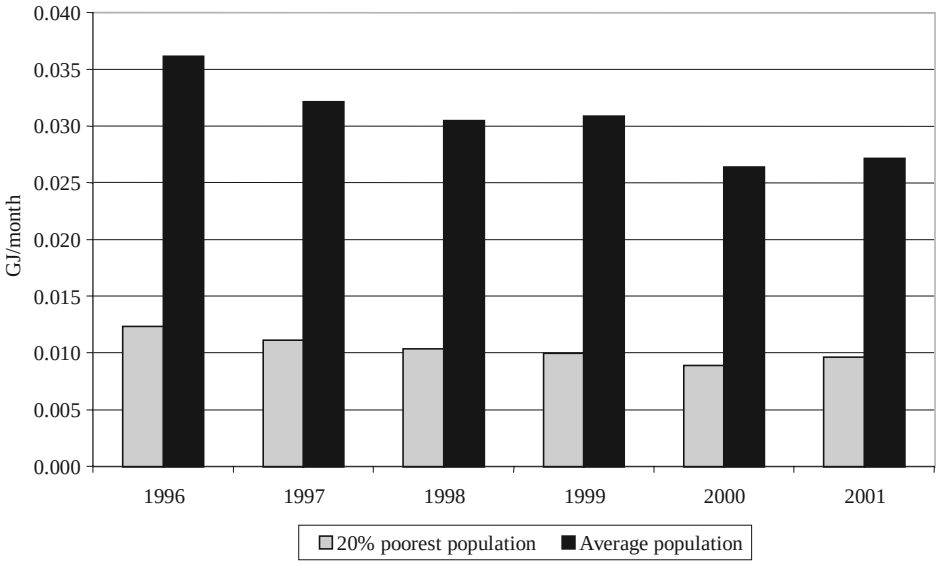

Fig. 6. The ratio of monthly disposable income per capita of 20% of poorest and average population to the prices of district heat

by dividing the population surveyed arranged in an increasing order according to the consumption expenditure level into ten equal parts. The first decile covers households with the lowest expenditure and the tenth decile covers the richest population group. So we used average data from the first two deciles to define the expenditures of 20% of poorest population. Seeking to calculate the share of expenditures on electricity, heating and fuel, data on the average consumption structure in this expenditure group for all deciles was applied.

As one can see from Fig. 4, the share of expenditures on electricity and household fuel by the average population is higher than by the group of 20% of poorest population. There is not great difference between the share of expenditures for electricity and household fuel of the poorest and the richest deciles. The biggest share of expenditures for electricity and household fuels are characteristic of the middle decile.

The last energy affordability indicator is the ratio of monthly disposable income per capita of the 20% of poorest population to the prices of electricity and major household fuels. Comparing this indicator with similar for average population, one can notice that energy affordability for the low income population is very low. For example, electricity consumption by low income population is almost three times lower comparing with the average (Fig. 5). This shows that the socially desirable level of electricity consumption will not be guaranteed for the low income population without state support. The situation is the same with heat consumption (Fig. 6). One can conclude that high energy prices *versus* the low income of population in Lithuania are a serious problem.

Total expenditures of households in the EU-15 in 1996 amounted to 1963 USD/capita per month. Total expenditures on household energy consumption in the same year amounted to 74.6 USD/capita and represented 3.8% of total household expenditures in that year [17]. The Lithuanian total household expenditures in 1996 amounted to 68.7 USD/capita. Total expenditures on household energy consumption in Lithuania amounted to 7.3 USD/capita and represented 10.8% of total household expenditures [16]. So the EU-15 average household energy expenditures were more than 10 times higher than in Lithuania. At the same time total household expenditures in EU-15 countries were about 30 times higher comparing with Lithuania.

By energy uses, in the EU-15 expenditures on space heating amounted to 36.52 USD/capita per month (50% of total energy expenditures) and in Lithuania to 2.32 USD/capita or 31% of total energy expenditures. Natural gas for cooking amounted to represented 5.5 USD/capita or 7.4% of energy expenditures in the EU-15 and 0.89 USD/capita or 12% of energy expenditures in Lithuania. Electricity represented 15.7 USD/capita or 21% of household energy expenditures in the EU-15 and 2.04 USD/capita or 27% in Lithuania.

Energy prices in the EU-15 for electricity in 1996 amounted to 0.13 USD/kWh, so the ratio of monthly disposable income to electricity prices in the same year or the electricity amount that can be consumed by population on average amounted to 304 kWh/capita per month. In Lithuania, the ratio of daily disposable income to electricity prices in the same year amounted to 39 kWh or was about 8 times lower.

District heat prices in Finland in 1996 were 109 USD/GJ, so the ratio of monthly disposable income to heat prices in the same year amounted to 0.34 GJ/capita per month [17] and in Lithuania the ratio of monthly disposable income to heat prices in the same year were 0.027 GJ/capita

per month, or the amount of heat that can be consumed by population on average per month was about 13 times lower than in the EU-15.

One can make a conclusion that the situation with energy affordability in Lithuania is worst in the heating sector, because district heat prices in Lithuania are very high (only by about 14% lower than in the EU-15 countries) as compared to the low disposable income of population. The amount of heat that could be consumed monthly or daily to current consumer prices and the available disposable income indicates that in Lithuania the amount of heat which can be consumed by population on average is 13 times lower than in the EU-15. The amount of electricity that could be consumed monthly to current electricity prices in Lithuania was 8 times lower comparing with the EU average, and the electricity prices were 2.3 higher in the EU-15.

To ensure energy affordability, social support schemes to low income population groups are necessary. As the current social income support system in Lithuania is not efficient, a new scheme should be implemented to protect low income population and to increase energy affordability. A deep analysis of such possible schemes is presented in [18].

6. CONCLUSIONS

The above analysis indicates that GDP/capita and energy consumption per capita are very low and shows the low living standards in Lithuania. Final energy consumption per capita in Lithuania is two times (electricity more than 3 times) lower than in EU-15. As the GDP/capita is increasing in Lithuania, electricity and final energy per capita is increasing since 2000.

Various studies have indicated that there is an income convergence among the two groups of countries, 15 EU countries and 10 new member states, and found the rate of convergence to be approximately 0.025%. Also, results of econometric studies indicated that up to 2020 we can expect energy intensities to converge to EU-15 levels significantly for all new EU member states, except Estonia. The actual level of energy demand in each of these countries between 2000 and 2020 will increase in all new member states in spite of the major decline in energy intensity. Thus it will not be feasible to use as a target for sustainable development a non-increasing level of total energy consumption.

The low energy consumption level in Lithuania is caused by the low energy affordability and other reasons. Several indicators for energy affordability assessment were developed and analyzed. There is no big difference between the share of expenditures for electricity in household of poorest and richest deciles in Lithuania. The biggest share of expenditures for energy is characteristic for the middle decile. Another important indicator, the ratio of monthly disposable income per capita of 20% of poorest population to the prices of electricity and major household fuels, shows that energy affordability for the low income population is very low in Lithuania. For example, electricity consumption for the low income population is almost 3 times lower as compared to the average. This shows that the socially desirable level of electricity consumption will not be guaranteed for the low income population without state aid. The situation is the same with natural gas and heat consumption. One can see that the high energy prices and the low income of the population in Lithuania is a serious problem.

A comparison of the ratio of monthly disposable average income per capita to the prices of district heating in Lithuania and the EU-15 average indicated that the EU-15 average household energy expenditures were more than 10 times higher than in Lithuania. At the same time the total household expenditures in EU-15 countries were about 30 times higher than in Lithuania.

The situation with energy affordability in Lithuania is worst in the heating sector, because district heat prices in Lithuania are very high as compared to the low disposable income of the population. The amount of heat that could be consumed monthly or daily to current consumer prices and the available disposable income indicate that in Lithuania the heat that can be consumed by the population is on average 13 times lower than in the EU-15. The amount of electricity that could be consumed monthly to current electricity prices in Lithuania was 8 times lower as compared to the EU-15 average and electricity prices were 2.3 higher in the EU-15. The daily disposable income to natural gas prices in Lithuania was about 4 times lower than in the EU-15. At the same time natural gas prices were 2 times higher in the EU-15.

To ensure energy affordability, social support schemes to low income population groups are necessary. The current social income support system in Lithuania is not efficient, because the targeting and coverage of this scheme is very low and should be replaced or improved.

There are no fundamental technological, economic, or resource limits constraining the world from enjoying the benefits of both high energy services and a better environment. This is not to suggest that these benefits are to be expected-only that they are achievable. Sustainable energy future depend on ambitious policy measures to promote sustainable energy development.

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SOCIALINIAI DARNAUS ENERGETIKOS VYSTYMOSI ASPEKTAI LIETUVOJE

Santrauka

Kai kurie aplinkos kokybës (bei gamtos iðtekliø naudojimo) ir pajamø, tenkanèiø vienam gyventojui, ryðio duomenys ágalina daryti prielaidà, kad aplinkos kokybë prastëja esant þemam pajamø lygiui, bet po to labai pagerëja pajamø lygiui padidëjus, o tai atspindi „spaudimo aplinkai atsiejimà nuo ekonominio augimo". Ðis nacionaliniø pajamø, tenkanèiø vienam þmogui, ir pramonës terðalø koncentracijø lygio ryðys yra vadinamas *aplinkos* Kuznets kreive, analogiðkai áprastinei Kuznets pasiûlytai kreivei, rodanèiai panaðø realiø pajamø, tenkanèiø vienam gyventojui, ir pajamø nelygybës ryðá.

Taèiau besivystanèios arba maþesniø pajamø ðalys gali pasimokyti ið turtingesniø tautø ankstesnës patirties ir panaudoti tokià politikà, kuri joms leistø „iðsikasti tunelá" aplinkos Kuznets kreivëje ir iðvengti aplinkos degradacijos piko, siejamo su áprastine plëtros trajektorija.

Energijos gamyba ir vartojimas tiesiogiai siejasi su ekonomikos augimu ir socialine plëtra bei turi tiesioginës átakos gyvenimo kokybei. Straipsnyje nagrinëjami energijos vartojimo ir gyvenimo kokybës klausimai Lietuvoje. Remiantis darnaus vystymosi socialiniø rodikliø analize, atliktas Lietuvos ir kitø ES ðaliø palyginimas. Nustatyta, kad þemas energijos vartojimo lygis atspindi ir þemus gyvenimo standartus Lietuvoje. Aukðtos energijos kainos gyventojams maþina galimybes naudoti energijà pakankamais kiekiais buityje.

Raktaþodþai: gyvenimo kokybë, energijos vartojimas

Даля Штреймикене, Юрате Зайкене

СОЦИАЛЬНЫЕ АСПЕКТЫ УСТОЙЧИВОГО РАЗВИТИЯ ЭНЕРГЕТИКИ В ЛИТВЕ

Резюме

Некоторые данные о взаимосвязи качества окружающей среды и использования природных ресурсов с доходами на душу населения позволяют делать довод, что качество окружающей среды ухудшается при низком уровне доходов на душу населения и значительно улучшается при росте доходов. Это отражает отклонение экономического роста от роста загрязнения окружающей среды и использования природных ресурсов. Эту взаимосвязь национального дохода на душу населения и концентрации антропогенных выбросов в атмосферу отражает так называемая кривая Кузнетса, аналогичная классической кривой Кузнетса, показывающей взаимосвязь доходов на душу населения и неравности доходов. Развивающиеся страны и страны с переходящей на рыночную экономикой могут и не повторять пути развития высоко экономически развитых стран. Можно использовать политические меры и „вырыть тоннель" в кривой Кузнетса, позволяющий перейти на более высокий уровень

национального дохода, обойдя пик деградации природных ресурсов и социального неравенства.

Ïðîèçâîäñòâî è èñïîëüçîâàíèå ýíåðãèè ïðÿìî ñâÿçàíû ñ ýêîíîìè÷åñêèì ðîñòîì è ñîöèàëüíûì ðàçâèòèåì, à òàêæå íåïîñðåäñòâåííî âëèÿþò íà êà÷åñòâî æèçíè è îêðóæàþùóþ ñðåäó.

Àíàëèçèðóþòñÿ ñîöèàëüíûå àñïåêòû ïîòðåáëåíèÿ ýíåðãèè â Ëèòâå. Ñ ïîìîùüþ àíàëèçà ñîöèàëüíûõ ïîêàçàòåëåé ðàçâèòèÿ ýíåðãåòèêè è ñðàâíåíèÿ ñî ñðåäíèì óðîâíåì àíàëîãè÷íûõ ïîêàçàòåëåé ÅÑ-15 óñòàíîâëåíî, ÷òî íèçêèé óðîâåíü ïîòðåáëåíèÿ ýíåðãèè îòðàæàåò íèçêèé ïðîæèòî÷íûé óðîâåíü â Ëèòâå, à âûñîêèå öåíû íà ýíåðãèþ íå ïîçâîëÿþò èñïîëüçîâàòü åå â áûò â äîñòàòî÷íûõ êîëè÷åñòâàõ.

Êëþ÷åâûå ñëîâà: ïîòðåáëåíèå ýíåðãèè, ñîöèàëüíûå ïîêàçàòåëè ðàçâèòèÿ ýíåðãåòèêè