
Comparative Analysis of Energy Sectors in Some Countries of Eastern Europe

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The analysis of energy sectors of countries all over the world is vital in a context of globalization and economic, social and environmental crises, because represents a way of identifying the problems and finding solutions that were implemented and worked in other countries. Our paper aims to compare the energetic sector of 6 Eastern European countries by analyzing the trend of energy production, consumption, prices and the main indicators needed to assess the achievement of required targets of 2020 Europe Strategy in the energy sector. The results show that each country has strong points or weaknesses in a smaller or a greater extent, but is important that authorities learn from each one of them and, on their basis, to create a sustainable management in the energy sector in each country.

Keywords: energy sector; energy efficiency; renewable energy; comparative analysis; Eastern Europe

Introduction

The energy sector has an important role in the growth of an economy and also in its stability because of its interactions with the other sectors. This role is emphasized both by strategies elaborated and implemented internationally that refers to sustainable development and green economy

and by the present energetic, food and financial crises in the context of globalization. These strategies present the main objectives and targets that need to be reached in the future by each country in order to create an effective result in solving the globally challenges, such as: climate change, pollution, poverty of population, economic and food crises, globalization.

The sustainable development model sustains that for an economic growth the countries must reduce greenhouse gas emissions by 20%, increasing renewable energy in the European energy mix by 20% and improving energy efficiency by 20% until 2020 compared to 1990 [1], but the current economic crises put some obstacles in achieving these targets, but that could be overcome. Also, the OECD promotes energy efficiency because of the positive impact on social and environmental aspects without which could not exist sustainable development.[2] The green economy model also highlights the need of energy efficiency, energy saving and energy security [3][4] and by that the big importance of the energy sector. Also, at a scientific level, the researchers debate these concepts and presented the controversial role of this sector in economy and environment [5] and patterns of correlation between different variables, such as: energy use and technical change [6], energy consumption, energy prices and economic growth [7], but has not been done a comparison of energy sectors from Eastern Europe. As a result, we started this research by wondering what is the situation of the energy sector in the Eastern Europe and we decided to use a comparative analysis, based on the data from international databases such as eurostat. There is no general applicable criterion to include countries in Eastern and Central Europe countries this is why we considered the United Nations statistical grouping, without making any comment on the inclusion of Romania in Eastern Europe, thereby arguing our chosen title. The United Nations grouping takes into account the following countries as part of Eastern Europe: Belarus, Bulgaria, Czech Republic, Hungary, Republic of Moldova, Poland, Romania, Russian Federation, Slovakia and Ukraine.[8] They also form part of the grouping made by EU for Eastern Europe, but beside these EU stipulates some other countries.[9]

These countries are characterized by the fact of being post-communist countries. In our paper we will do a comparative analysis on the energy sectors of Bulgaria, Czech Republic, Hungary, Poland, Romania and Slovakia, countries that are all in European Union. The main objectives of this paper were to make a short analysis of some social, economical and

environmental indicators in each country for helping to understand better the sectors analysis, to make a comparative presentation of energy production, consumption, prices and then to analyze and evaluate some indicators important in achieving European required targets in the energy sector. One of the limits of this research is that analyze only some indicators from the energy sector and so its accuracy is diminished. Also, the analysis would be more complete if it will be added to the comparative analysis the West European countries, BRIC countries, Japan, USA and if it will be compared the energetic potential in each country.

Characteristics of analyzed countries

In order to create a relevant comparison between the chosen Eastern Europe's countries, we considered first reviewing some social and economical indicators' trends. In what concerns the population, the right ascending order of analyzed countries is: Poland (with almost 39 million persons, the highest population of all and three times higher than the others, except Romania), Romania (with more than half of Poland's population), Czech Republic, Hungary, Bulgaria and Slovakia. According to European Commission projections by 2060 [10], the population from Bulgaria, Hungary, Poland and Romania will decrease and from Czech Republic and Slovakia will have an ascending trend by 2025 followed by a descending trend. In 2011, the population density was of 135.9 inhabitants per km² in Czech Republic, thus having the highest value, followed by Poland (132.2 inhabitants per km²), Slovakia (110.1 inhabitants per km²), Hungary (107.2 inhabitants per km²), Romania (93 inhabitants per km²) and Bulgaria (67.5 inhabitants per km²). The people at risk of poverty or social exclusion represented in fig.1 was between 2007-2012 around 49% in Bulgaria, around 41% in Romania, around 26% in Poland and about 21% in Slovakia, but for these countries the trend is declining. For Czech Republic and Hungary, is presented a negative situation because the risk of poverty or social exclusion is increasing to around 15% and 32%. One factor of influence in the trend of this indicator could be the strategies in reducing poverty and social exclusion implemented at national level and we consider that Romania must still work at this strategy efficiency.

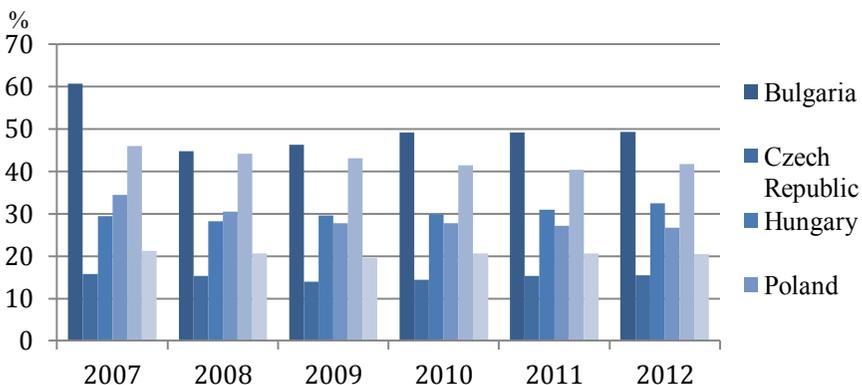


Figure 1: People at risk of poverty or social exclusion

When we analyzed the gross domestic product at market prices through the purchasing power standards per inhabitant in the period in question we could notice that all the analyzed countries except Czech Republic have a higher purchasing power per inhabitant in 2012 than in 2007, but still Romania and Bulgaria were occupying the last positions. The real GDP growth rate, calculated on previous year, allows a comparative analysis of the economies of countries considered. The fig.2.shows the impact of the current crisis on economy and that overall Czech Republic and Hungary are the most affected countries in the period of 2007-2012 and Poland had the most positive trend.

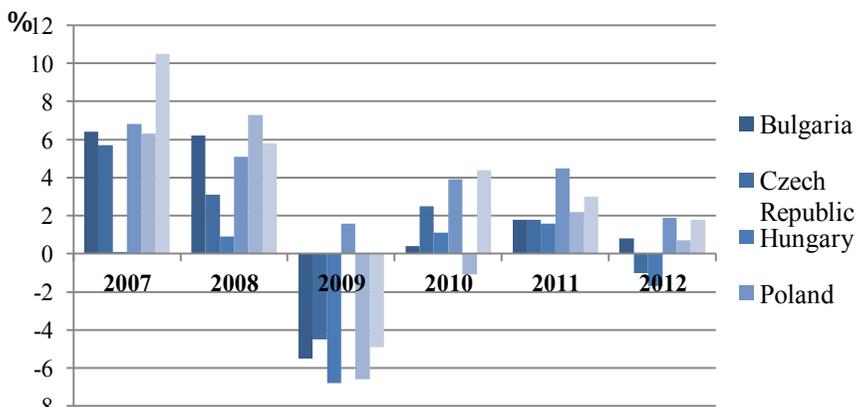


Figure 2: Real GDP growth rate - volume

Another indicator for measuring the economic welfare is the real GDP per capita represented in fig.3, which shows an increase in Poland's welfare, Slovakia's welfare and slightly in Romania's and Bulgaria's welfare, but the discrepancies between Romania and Bulgaria and the rest of the analyzed countries are high.

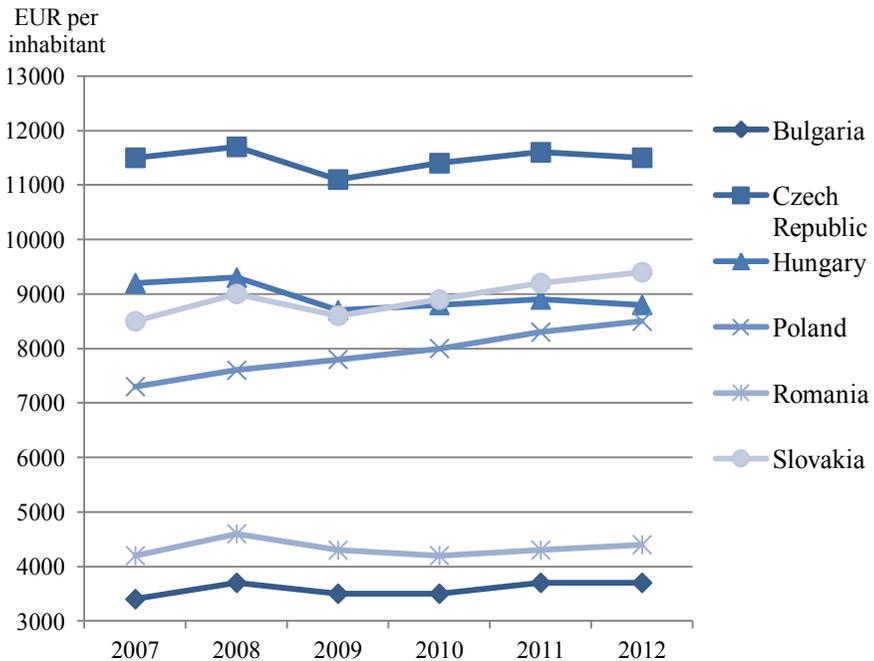


Figure 3: Real GDP per capita

In order to perform a better sector analysis, besides social and economic indicators, should be considered also the general environmental indicators as an addition to the specific ones of the sector. These refer to environmental protection expenditure, environmental investments, and international trade of mineral fuels, lubricants and related materials. We observed a strict increasing trend of percentage of the environmental protection expenditure made by public sector for Slovakia during 2007-2011 and its almost double increase for Romania in 2011 than 2007. By reporting this percentage to GDP's volume for the analyzed countries we can state that the best evolutions of this indicator were of Czech Republic, Romania and

Poland. In other words, in these countries the public sectors have spent the highest amount of money for environmental protection than the others. In what concerns the industry investment the situation is somehow different because Bulgaria had the higher percentage in 2008, but was declining and reached in 2011 the minimum amount allocated from GDP. The countries with the best percentage were also Czech Republic, Poland and Romania. During 2007-2011 the environmental investment made by industry has declined.

Energy production, consumption, prices and taxes

To express better the comparison, we presented the total energy production and consumption in fig.4 and fig.5. As a result, we observed that the consumption of primary energy was in 2011 higher than the production of primary energy in all states, but Bulgaria, Czech Republic, Hungary and Romania have decreased during 2007-2011, which means that these countries are trying to achieve the objectives of 2020 Europe Strategy in reducing the consumption of energy.

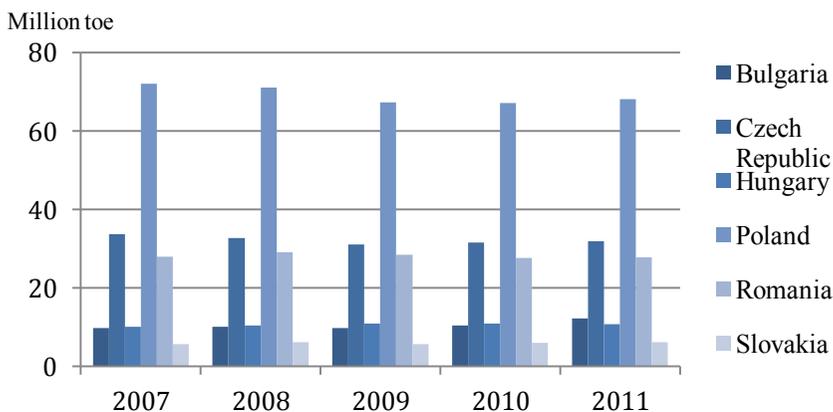


Figure 4: Total production of primary energy

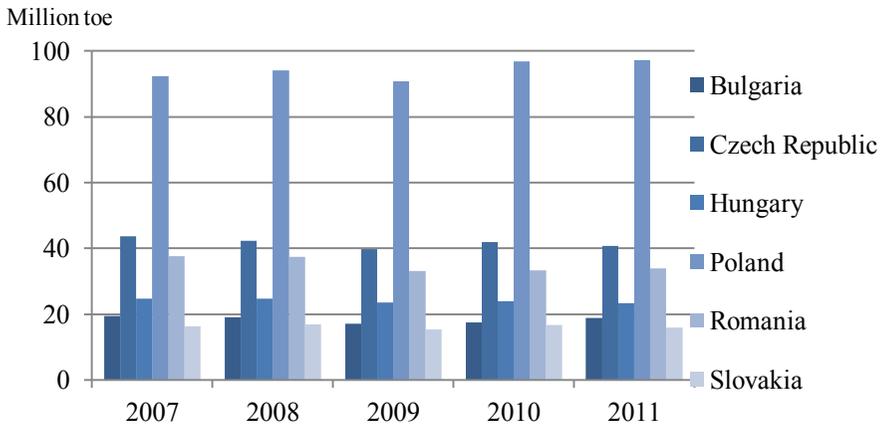


Figure 5: Primary energy consumption

Also, the final energy consumption, which refers to the energy supplied to all sectors of economy, had a slight decrease in trend in almost all countries except Poland and Slovakia compared with the 2007 year. In what concerns the prices in the energy sector, we observed decreases of prices for industrial consumers in Romania and Hungary during 2007-2011, but with increases after 2012. The other countries had a trend of rising prices between 2007 and present. For household consumers, the gas prices declined only in Romania. Reporting to 2011, the lowest price for industrial consumers was in Romania of 4.23 EUR/Gigajoule while the highest price was in Slovakia of 9.22 EUR/Gigajoule and for the household consumers the lowest price was also in Romania of 4.14 EUR/Gigajoule while the highest price was in the Czech Republic of 12.6 EUR/Gigajoule [10]. In 2013, the situation is changing only for the industrial consumers for which the order of the size prices were changing especially in Bulgaria and Hungary switching places; Bulgaria climbing on the fifth place as value in ascending order and Hungary descending on the second place. An atypical fact is that in Romania the prices of gas for the industrial consumers are higher than the ones for the household consumers. This happens because of the alignment of prices to the European ones, alignment which is happening sooner for industrial consumer than household consumers. In case of

electricity prices for industrial consumers, the smallest value in 2011 was for Bulgaria with 0.0638 EUR per kWh, followed by Romania with 0.0803 EUR per kWh, Poland, Hungary, Czech Republic, while the highest price was for Slovakia with 0.1233 EUR per kWh. For household consumers the order is quite similar, only that Hungary is switching places with Poland. In 2011, the lowest price of electricity was in Bulgaria with 0.0688 EUR per kWh while the highest price was in Slovakia with 0.1372 EUR per kWh [10]. In the case of household consumers these prices should be compared with the GDP per capita to determine a better analysis and thereby the things get more complicated because of households' purchasing power. The country disadvantaged by this point of view in 2013 is Bulgaria because of high gas price compared to real GDP per capita. We think that these fluctuations of prices are influenced by trade balance, by country potential of energetic resources, by international markets and so on.

Another relevant indicator for energy is the implicit tax rate on energy. This tax rate shows the tax revenue raised per unit of energy consumed [11]. The highest implicit tax rate on energy was in 2011 in Poland of 93.8 EUR per tone of oil equivalent while the lowest tax rate was in Slovakia of 48.5 EUR per toe [10], meaning that the differences between analyzed states were high and that the highest tax burden was in Poland.

Indicators for achieving European required targets in the energy sector

Given that the six countries analyzed are part of the European Union, they should align to the requirements, regulations and directives of the European energy sector and to try to achieve the 20/20/20 targets of European strategy for development, but the members of EU chosen each one a target of their one. At European level it is promoted an increase of renewable energy in the European energy mix by 20%, a reduction in greenhouse gas emissions by 20% and an improvement of energy efficiency by 20% until 2020 compared to 1990[1].

In what concerns the share of renewable energy sources in the total energy consumption, Bulgaria assumed in its strategy a mandatory target of only 16%, Czech Republic 13%, Hungary only 13%, Poland 15%, Romania 24% and Slovakia 14%.[12] As can be seen in fig.6, Slovakia had in 2011 the highest share of renewable energy in total production of primary energy while Czech

Republic had the lower share. During 2007-2010 the trend was ascending for all states, but after 2010 we noticed a descending trend for Bulgaria, Hungary, Romania and Slovakia. A motive of this change can be because 2011 was a very important year in implementing new instruments for helping the energy sector. For example, in Romania, 2011 was the year when was implemented the green certificate scheme for promoting the energy obtained from renewable sources. So, by investing in renewable technologies and by implementing some support instrument for this field, both from public and private sectors, will help increasing the production of energy obtained from renewable sources, which will further lead to consumption growth of renewable energy allowing it to achieve the assumed targets and to reduce emissions of greenhouse gases. Comparing the share of renewable energy in total production of primary energy with the share of renewable energy in gross final energy consumption, we noticed that in Hungary and Slovakia the first indicator was over two times higher than the latter, situation that can be explained by the fact that these countries have exported renewable energy and the rest of the countries have imported energy. For the share of electricity generated from renewable sources in gross electricity consumption we observed a good positioning of Romania compared with others states, this situation being possible also because of the hydropower already developed in this country.

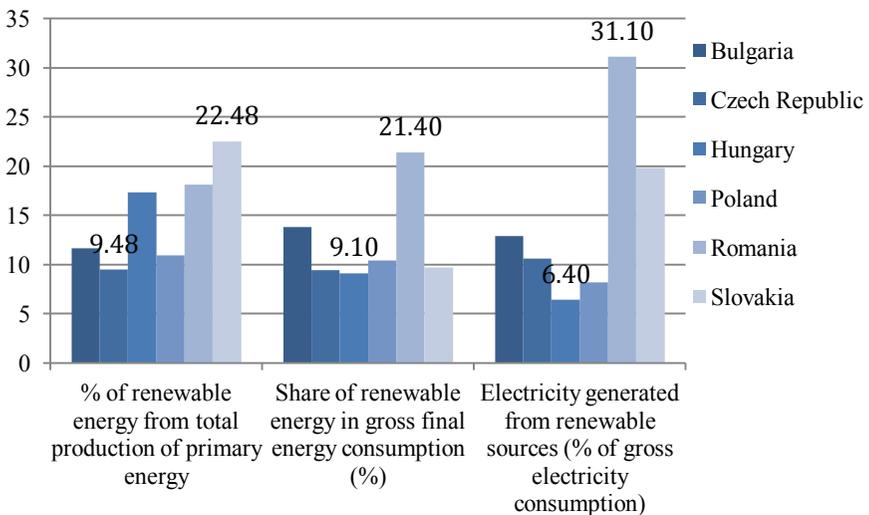


Figure 6: Indicators for renewable energy

For achieving the reduction of greenhouse gas emissions by 20% until 2020 compared to 1990, we analyzed the reductions in each country in question. So, in table 2 can be seen that in 2011 the only country that did not yet achieved its target of reduction was Poland; this could be explained by the fact that has a developed industrial sector. Also, since 2005 through the implementation of emission trading scheme has been discussed a new target of another 21% in reducing greenhouse gas emissions by reporting on 2005. In table 2 we forecasted the target to which the countries in question may arrive if they apply the 21% reduction and we noticed that Hungary it is the closest one to 21% reduction in emissions compared to 2005.

Table 2

Index (1990 = 100)	Bulgaria	Czech Republic	Hungary	Poland	Romania	Slovakia
Greenhouse gas emissions in 2011	60.45	68.42	67.19	87.56	50.46	63.19
Greenhouse gas emissions in 2005	58,34	74,43	80,57	85,47	57,89	70,55
Forecast of reduction of greenhouse gas emissions reported to 2005	37,34	53,43	59,57	64,47	36,89	49,55

To measure the energy efficiency of a nation's economy we presented in fig.7 the energy intensity of the economy in each country. The higher the level of this indicator is the lower energy efficient is a state. So, during 2007-2012, the lowest efficient country from the analyzed ones was Bulgaria, because of the low GDP per capita, a high risk of poverty or social exclusion and other social, economical and environmental factors. Hungary had the lowest energy intensity of economy, which means the best energy efficiency from the countries in question, fact that we consider is because of the good environmental policies, of the average GDP per capita, risk of poverty or social exclusion and other social, economical and environmental factors that we did not took into consideration, such as: inflation rate, employment rate, living conditions, climate conditions and so on.

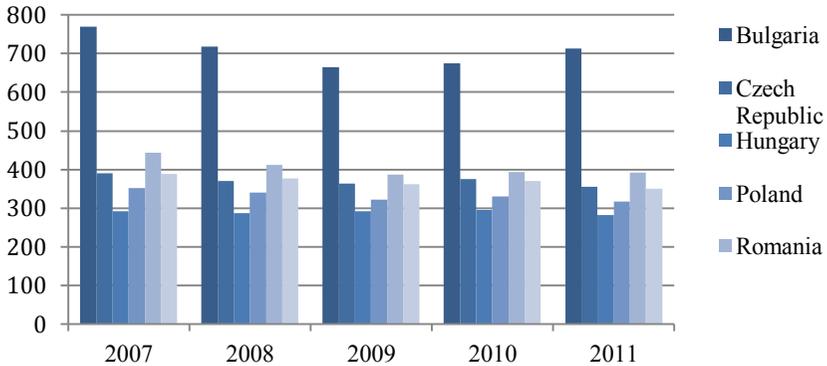


Figure 7: Energy intensity of the economy

We also analyzed the energy dependence of a country and we observed that in 2011 Romania was the least dependent of considered states, that is because has good energy resources and also had implemented renewable energy strategies which attracted investors in energy sector and thereby increasing the energy production. Given the fact that this countries depend on imports is also important the trade balance of mineral fuels, lubricants and related materials, which is negative for all the states. This brings into discussion the energy security in these countries. To identify the problem it must be analyzed in relation with the potential of resources and their use. In this paper we identify that exist unexploited potential of renewable energy and that these states could invest in energy sector to develop it and to diminish the dependence of imports and to grow energy efficiency.

Conclusions

This paper highlights the main social, economic and environmental indicators needed for a better comparing and analyzing the energy sectors in Bulgaria, Czech Republic, Hungary, Poland, Romania and Slovakia and analyzes the evolution and implications of these sectors during 2007-2011.

First of all, we have shown that Bulgaria occupies the worst position among the states analyzed regarding the energy sector, one reason being the fact that she and Romania entered last in the European Union and have not

been aided as it happened in the case of other Member States. From all the analyzed indicators, we identify for Bulgaria only the following positive things: has a good rate of environmental protection expenditure, the highest rate of environmental investment made by industry with positive effects on economy and the lowest electricity prices.

Secondly, we observed that Czech Republic has some strong points compared to the analyzed countries, such as: the lowest level of the risk of poverty or social exclusion, the highest real GDP per capita, the highest environmental protection expenditure made by the industry and a small dependency of energy imports, indicators that contribute to a relatively efficient energy sector as a result of comparing the energy intensity of the economy in all the 6 states. Also, we identify some weaknesses in the energy sector of Czech Republic, such as: the highest level in gas prices for household consumers, almost the highest price level in electricity, a high energy tax burden of the country, a small share of renewable energy in total production of primary energy and in gross final energy consumption and a small reduction of greenhouse gas emissions.

Thirdly, Hungary has as strong points the relatively small gas price for household consumers, a good percentage of renewable energy in total production of primary energy, the best energy intensity of the economy from all considered states and as weaknesses a low rate of environmental protection expenditure made by industry, environmental investments made by industry, a high energy dependence of imports. For the rest of analyzed indicators its positioning is medium.

Fourthly, we have shown that Poland has almost all indicators to a medium – high level, but has the highest production and consumption of energy of all states that is because the population is numerous. Also has the biggest tax burden on economy and need to invest more in renewable energy to diminish the greenhouse emissions.

Fifthly, in Romania was observed a good share of renewable energy in production and consumption, a lowest level of greenhouse gas emissions and the smallest energy dependence of imports, but a low level of environmental investments made by industry until 2011. This could have a way better level after 2011 when was introduced and applied the renewable energy promotion scheme and was regulated the green certificates' market. Finally, Slovakia has the highest grade of energy dependence and the highest electricity prices from all states, but has the best percentage of renewable

energy in total production of primary energy and the lowest implicit tax rate on energy, meaning that the energy tax burden for the country is small.

This research can be a starting point for a wider study in analyzing the international energy sector, as well as, for improving the strategies and instruments used in this field. Based on this work, the public authorities, and not only, can act to those weak points of the energy sector in each country in order to take better-informed decisions, that are vital for all healthy economies.

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