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Energy security and sustainable competitiveness of industry development

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The article deals with an urgent contemporary issue of sustainable development by tackling controversy and incompatibility of economic aims: to combine energy security, economic growth, steward environmental health and maintain long-term competitiveness. A discussion about perception of energy security, future trends of energy consumption, economic growth and mode of impact of energetically secure economic growth on environment and level of international competitiveness is elaborated on. The authors suggest conceptual approaches towards formulating measurable aims for sustainable and internationally competitive economic developments, which would allow us to achieve comparative compatibility of unrestricted energy availability and development of industrial constitute of countries economies, which would not lead to gradual degradation of environment and decline of international competitiveness in the long run.

Keywords: energy security; sustainable development; industry development; international long-term competitiveness

JEL classifications: O1, C5, L7

1. Introduction: posing the main research question

The approach to energy security and sustainable industry development suggested in this article is new in the light of issues which are being elaborated within a framework of economic growth and sustainable development research areas (Balkytė & Tvaronavičienė, 2010; Baublys, Miškinis, Konstantinavičiūtė, & Lekavičius, 2015; Bilevičienė & Bilevičiūtė, 2015; Bilgin, Lau & Tvaronavičienė, 2010; Ciemleja, Lace, & Titko, 2014; Dezellus, Ferreira, Pereira, & Vasiliūnaitė, 2015; Endrijaitis & Alonderis, 2015; Grybaitė, 2011; Lankauskienė, 2014; Lankauskienė & Tvaronavičienė, 2011; Laužikas & Krasauskas, 2013; Mačiulis & Tvaronavičienė, 2013; Makštutis, Balkytė, & Tumalavičius, 2012; Marrero, 2010; Mostenska & Bilan, 2015; Šimberová, Chvátalová, Kocmanová, Hornungová, & Pavláková Dočekalová, 2015; Šimelytė & Antanavičienė, 2013; Smaliukienė, Dudzevičiūtė, Adekola, & Aktan, 2012; Stańczyk, 2011; Tvaronavičienė, 2012; Tvaronavičienė, 2014; Tvaronavičiene, Grybaite, & Tvaronavičiene, 2009; Tvaronavičienė & Kalašinskaitė, 2010; Travkina & Tvaronavičienė, 2011; Vasiliūnaitė, 2014; Vosylius, Rakutis, & Tvaronavičienė, 2013).

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We raise the following question: if development of economic activities and especially industry requires increasing volumes of energy, how we should curb the inevitable negative impact on the environment from such economic development? To follow up the logic of economic thinking would suggest the next question: could it be, that availability and affordability of energy through resulting economic growth leads us to unstoppable environmental degradation? If that logic is supported by theoretical grounding and empirical evidences, can we make an ultimate statement, i.e., can we make a presumption about the incompatibility of aims to be unrestrictedly energy secure and develop sustainably? That is a novel approach in sustainable development literature, which is built on by a vast amount of literature in the field of sustainable development.

Despite of frequent use of concept 'energy security', it appears that there is no unanimous agreement about how energy security can be defined and understood. The understanding about what energy security is starts from pointing to its availability, i.e. steady production or/and supply, its affordability to composite and complex definitions, which embrace energy source composition; energy efficiency and energy prices (Baublys, Miškinis, Konstantinavičiūtė, & Lekavičius, 2014; Dezellus et al., 2015; Karnitis, 2011; Miškinis, Baublys, Lekavičius, & Morkvėnas, 2013; Raudeliūnienė, Tvaronavičienė, & Dzemyda, 2014; Vosylius et al., 2013). Let us stop on the simplest definition, that a country's energy security means energy availability; i.e. we presume that once energy is available it could be used in quantities required. Here we do not take into account energy price and ignore the laws of supply and demand, which suggest that the higher the price, the smaller the quantity consumed. We assume that energy as a good is being characterised by complete inelasticity. Complete inelasticity from an economic point of view would mean that an increase in price does not affect the quantity consumed. Hence, in our case, we ignore aspects of energy affordability and assume that energy is affordable, at least to the industry sector, and price does not affect production volumes and competitiveness of export (Dezellus et al., 2015; Smaliukienė et al., 2012; Tvaronavičienė, 2014; Vasiliūnaitė, 2014). Despite the assumption we provide here this has to be attributed to a category of research limitations, there is research, which verify this scientifically-limited assumption. After defining energy security the perception in this article allowed us to switch to discussions about sustainable industry development. We remind the reader that clarification of concepts here is absolutely crucial, since we are going to trace the character of interrelation between two multifaceted phenomena. Hence, only very precise definitions of what is meant by concepts remaining as objects of ongoing discussion could lead to sensible and valuable insights.

By sustainable industry development we mean economic expansion of economic activities internationally attributed to the industrial sector which does not increase levels of environmental degradation and remain competitive in the long-run due to the gradual diminishing of energy intensity.

Here we need to point out that the definition of sustainable industry development is original. The vast amount of scientific and political literature usually tackles not sustainable industry development (Tvaronavičienė, 2014), but rather the sustainable development of a whole economy or country (Dezellus et al., 2015; Grybaitė, 2011; Mačiulis & Tvaronavičienė, 2013; Raudeliūnienė et al., 2014; Stańczyk, 2011; Vasiliūnaitė, 2014). The first aspect of novelty, as it was indicated above, lies in choosing a specific industry, as an object of sustainable development. We explain this approach using the following argument. Economic growth leads to higher energy consumption in various segments of the economy; the major consumers are households, the second in terms of size is transport, and the third the biggest consumer is industry. The international competitiveness of the country is very tightly related to ability to expand its export. A major part of export still depends on industrial activities (services are exported as well, but still major object of export remain industrial goods, not services). Keeping in mind the argument above, we reckon that while impact of household activities and transport mode could be affected by relevant consumption culture changes (Dzemyda & Raudeliūnienė, 2014; Raudeliūnienė et al., 2014), innovations (Dudzevičiūtė, Mačiulis, & Tvaronavičienė, 2014; Dudzevičiūtė & Tvaronavičienė, 2011; Hoffmann & Prause, 2015; Ignatavičius, Tvaronavičienė, & Piccinetti, 2015; Tvaronavičienė, 2014; Tvaronavičienė, Šimelytė, & Lace, 2014; Tvaronavičius, Dudzevičiūtė, & Tvaronavičienė, 2010) and implementation of innovative solutions for energy efficiency (Ala-Juusela, Short, & Shvadron, 2014; Barberis, Di Fresco, Santamaria, & Traverso, 2014; Baublys et al., 2014; Cuneo, Ferrari, Traverso, & Massardo, 2014; Guruz & Scherer, 2014), industries' activity is affected additionally by such factors as technology transfer and management mode (Baikovs & Zariņš, 2013; Bistrova, Lace, & Tvaronavičienė, 2014; Endrijaitis & Alonderis, 2015; Figurska, 2014; Garškaitė-Milvydienė, 2014; Giriūnas & Mackevičius, 2014; Ignatavičius et al., 2015; Peker, Tvaronavičienė, & Aktan, 2014; Tvaronavičiene et al., 2009; Wahl & Prause, 2013). Approaches towards entrepreneurship in societies and entrepreneurship conditions (Caurkubule & Rubanovskis,2014; Dezellus et al., 2015; Dzemyda & Raudeliūnienė, 2014; Giriūnienė, 2013; Giriūnienė & Giriūnas, 2015; Goyal & Sergi, 2015; Ignatavičius et al., 2015; Išoraitė, 2013; Laužikas & Mokšeckienė, 2013; Prause & Hunke, 2014; Raudeliūnienė et al., 2014; Šabasevičienė & Grybaitė, 2014; Tunčikienė & Drejeris, 2015; Tvaronavičiene et al., 2009) also affects long-run industries competitiveness.

2. Industry development and sustainability issues

In order to elaborate on insights related to the research question thoroughly described above, we need to provide comments on the scientific discussion in the field of sustainable development and environmental degradation.

After a critical review of the main statements of the ongoing discussion we turn to the topic of energy security and will merge main insights into one critical elaboration, which, we believe contribute to economic, and particularly, recent sustainable development observations, and would trigger responsive reaction of scientists and practitioners.

Let us start from a very common approach to the issue of interrelationship between economic growth and environmental degradation. In order to be concise here, let us state that two dominant approaches can be distinguished. The proponents of the first, the more primitive approach, claim that economic growth and environmental degradation have no relation, hence, the problem of economic growth in terms of hindering sustainable development does not exist. The next approach is more sophisticated but, nevertheless, more prominent and recognised. It claims that economic growth causes environmental degradation – the tendency is vivid at early stages of countries' development. Later, at certain point, a certain stage of development, the consistent pattern changes, and as the country continues its path of development, environmental degradation stops and even diminishes. So we have to take into account that inverse U relationship between countries' development and environmental degradation exists. Before a country reaches a certain point, it harms the environment; after it moves to the next, advanced stage of development, its further development stops being harmful to environment. This consistent pattern is known as Kuznets curve (Ahmad & Al Sayed, 2013; Čiegis, Štreimikienė, & Zavadskas, 2008; Culas, 2012; Fosten, Morley, & Taylor, 2012; Huang, Lee, & Wu, 2008; Iwata, Okada, & Samreth, 2010; Lapinskienė, Tvaronavičienė, & Vaitkus, 2014; Saboori & Sulaiman, 2013).

Scientists dealing with Kuznets curve work on questions related to facilitating transition to the stage of development, where a complex set of means is being adopted (policy tunnel in order to push trajectory of Kuznetz curve down) (Lapinskienė et al., 2014).

The consistent pattern described above triggered an emotional reaction, which is vividly represented by such publications as *The Limits to Grow* (Ekins, 1993). Keeping in focus contradictions between economic growth and economic degradation, authors panic and provide a series of pessimistic scenarios of the future world. They do not believe the top of an inverse U curve could be reached fast enough. We state that scenarios of a similar character impressed not only scientists, but politicians, movie makers and other stakeholders in society. In some cases imagination was released and flourished with menacing scenarios of mankind's future.

We claim that optimistic or pessimistic scenarios of development ultimately depend on the scale of energy consumption, which is caused by economic development. Recall that the object of our analysis is the industrial sector. We claim that the impact of industrial development on environmental degradation will depend on resulting energy consumption. Energy consumption, in turn would depend considerably on energy intensity characteristics.

The industrial sector of the economy of any country is not homogeneous. It is comprised of industrial sub-sectors (it is agreed internationally which activities are attributed to which sub-sector). It is necessary to take into account that different sub-sectors of economy are characterised by different energy intensities. Even more so, due to different susceptibility to relevant innovations (Dudzevičiūtė et al., 2014; Tvaronavičienė, 2014; Vasiliūnaitė, 2014) and structure of activities which comprise those sub-sectors, sub-sector energy efficiencies' change can differ significantly in terms of rates and even direction.

Hence, in order to come to conclusion, what happens after the industrial sectors develops, if it will compliment or contradict sustainable development and long-term competitiveness goals, we need to have a clear view of the trends of development for the whole industrial sector (Dudzevičiūtė, 2013; Dudzevičiūtė et al., 2014; Tvaronavičienė, 2014) and its constituents, i.e. sub-sectors, which in turn are being comprised from specified activities. In order to be able to predict the impact of industrial sector development on sustainable development and long-term competitiveness, we need to forecast scales of activity, the corresponding amount of energy required – which in turn will be dependent on energy efficiencies in industrial sub-sectors. Such forecasts will be treated as empirical evidence, letting us come to the insights, which let us answer the scientific questions posed at the very beginning of this article. Let us put emphasis on our major research questions one more time: we strive to discover if energy security, understood as the unrestricted availability of energy, would not be detrimental to sustainable development through gradual increase of energy use. This would naturally lead to gradual environmental degradation unless energy intensity diminished considerably (*ceteris paribus*, i.e. if conditions remain the same and particular policies are not being implemented).

The latest decade of energy intensity of the economy's sectors as a factor impacting sustainable development of countries is being thoroughly discussed (Baodong & Xiaokun, 2011; Dudzevičiūtė, 2013; Dudzevičiūtė et al., 2014; Fujii & Managi, 2013; Vasiliūnaitė, 2014). We put additional emphasis on long-term competitiveness, which could be achieved only in cases of diminishing energy intensity (Ala-Juusela et al., 2014; Barberis et al., 2014; Baublys et al., 2014; Cuneo et al., 2014; Guruz & Scherer, 2014; Vosylius et al., 2013). We can conclude that almost unanimous agreement between economists, politicians and practicians exist about controversial interrelation of economic growth and enviromental implication. The famous Cuzmec curve is the best reflection of this interrelation: as a poor country develops, it uses more energy and emits increasing amounts of greenhouse gas (GHG). As the economy reaches a certain, sufficiently high level of develoment, the volume of emitted gas reduces, despite the economy continuing its development. That consistent pattern suggests that each country has to negotiate a structure of its economy, which is the least energy intensive and, hence, generates the smallest possible amount of GHG. That is what is meant by sustainable development.

We asume that empirical evidence of consequences of industry sector development can be found by performing mathematical modelling or, rather, simulation allowing us to forecast activity levels and industry branch energy intensity for the mid-term period, in our case until the year 2030. For that purpose we would employ software Long-range Energy Alternatives Planning (LEAP), which is used for energy balance calculations, when initial conditions are being simulated (Heaps, 2012). The scenario analysis allows us to shed light on the future tendencies of industry sub-sector development expressed by volume of activity, energy required and forecasted energy efficiency. Before looking at the results of matematical modelling or simulation, let us provide a description of LEAP softaware, which we will use for the previously mentioned purposes.

Scenario analysis is at the heart of using LEAP. Scenarios are self-consistent story-lines of how a future energy system might evolve over time in a particular demographic and socio-economic setting and under a particular set of policy conditions. LEAP is developed and managed by Charles Heaps of the Stockholm Environment Institute (SEI) (Heaps, 2012).

Major funders of LEAP have included: The SEI, The Government of the Netherlands, The Government of Sweden (Sida), The United Nations Environment Programme (UNEP), The United Nations Industrial Development Organization (UNIDO), The United States Environmental Protection Agency (US-EPA), The Energy Foundation and The US Agency for International Development (US-AID).

The original version of LEAP was conceived in 1980 by Paul Raskin of Tellus Institute. Other major contributors have included: Jack Sieber, Steven Bernow, Nicolas di Sbroivacca, Gordon Goodman, Evan Hansen, Michael Lazarus and David von Hippel.

The key assumption is that branches contain various indicators drawn from the UN, World Bank, UNIDO and other data sources. Based on information from a variety of sources including: International Energy Agency World Energy Balances (IEA, 2008), United Nations Population Prospects (UN, 2008), World Bank Development Indicators (World Bank, 2010), UNIDO INDSTAT4 (UNIDO, 2009), IPCC default GHG emission factors (IPCC, 1997), World Energy Council Survey of Energy Resources (2007), World Resources Institute CAIT database (2008), Energy Information Administration (EIA) International Energy Outlook (2009) and the European Commission, European Economic Forecast (Spring, 2010).

2.1. Assumptions for modelling

In order to perform mathematic modelling or simulation key assumptions have to be formulated. Hence we make the following assumptions. The first assumption is about energy intensity. We make a rather pessimistic assumption that energy intensity will grow by 2%.

The second assumption is about expected economic growth. Hence, GDP is assumed to grow by a rate of 2%, which is considered a healthy growth rate estimating from a macroeconomic point of view. Let us recall what MER means; GDP could be measures by Market Exchange Rate (MER) and Purchasing Power Parity (PPP) (World Bank & World Development Indicators, 2010). The third assumption relates to the structure of the industrial sector. We make the assumption that the composition of sub-sectors comprising the economic sector and the composition of activities comprising the economic sub-sectors will remain the same.

The results of modelling, or simulation, will be provided. We will consider forecasted GDP, energy consumption and energy intensity in Lithuania. The time span is up to the year 2030. This time span represents the middle term in forecasting.

Figures 1 and 2 provide as view of the future economic development of Lithuaninan GDP and economic development of industrial sector. We see that the economy of Lithuania is going to develop; the industrial sector, which is constituent of GDP, grows respectively. Now energy demand analysis, which corresponds to depicted economic activities development has to be performed. The principles of such a demand analysis are being provided below.

2.2. Final energy demand analysis

Final energy demand evolves over time in a particular socio-economic setting and under a particular set of policy conditions. In other words:

$$D_{b,s,t} = TA_{b,s,t} \times EI_{b,s,t} \tag{1}$$

where $D$is energy demand, $TA$is total activity, EI is energy intensity, b is the branch, s is scenario and t is year (ranging from the base year, the first historical year of a LEAP analysis.[0] to the end year). Note that all scenarios evolve from the same Current Accounts data, so that when $t = 0$, the above equation can be written as:

$$D_{b,0} = TA_{b,0} \times EI_{b,0} \tag{2}$$

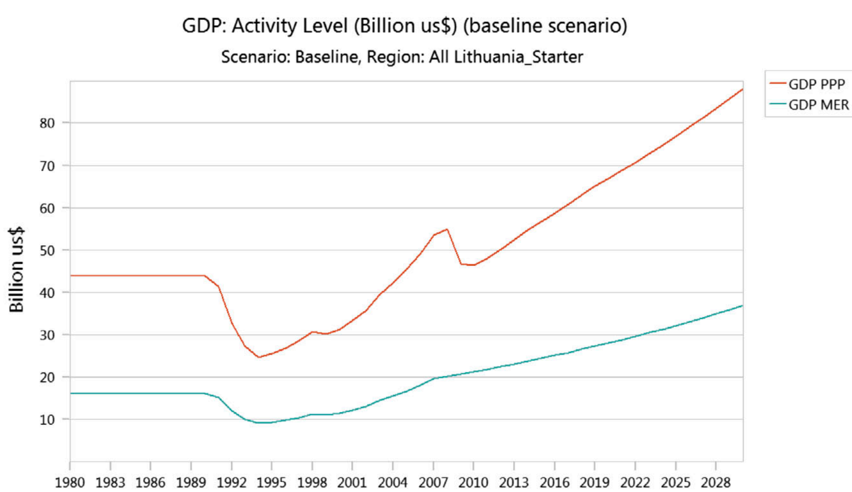


Figure 1. GDP change up to the year 2030.
Source: Authors' analysis.

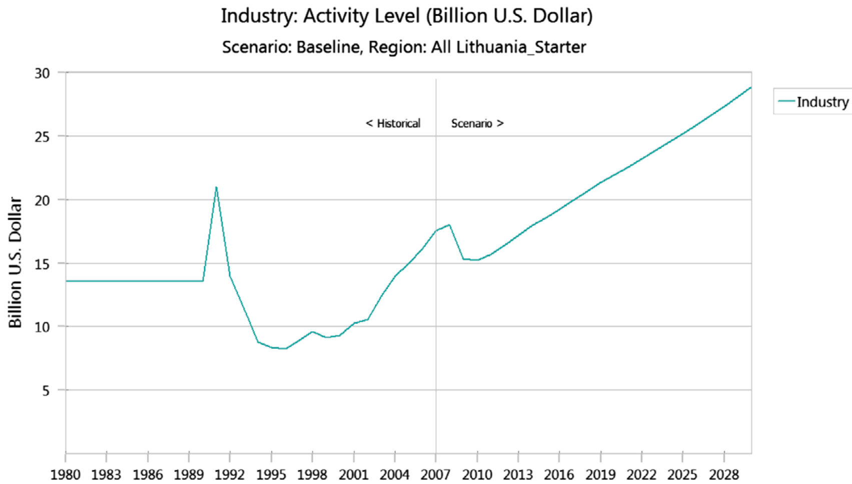


Figure 2. Industry sector change up to the year 2030.
Source: Authors' analysis.

The energy demand calculated for each technology branch is uniquely identified with a particular fuel used to produce energy. Thus, in calculating all technology branches, LEAP also calculates the total final energy demand of each fuel. The total activity level for a technology is the product of the activity levels in all branches from the technology branch back up to the original Demand branch. In other words (Heaps, 2012):

$$TA_{b,s,t} = A_{b',s,t} \times A_{b'',s,t} \times A_{b''',s,t} \times \ldots \tag{3}$$

In scenarios**,** you enter expressions to independently project the Current Accounts values calculated above for the useful energy intensity of the aggregate energy intensity branch, the technology activity shares and their efficiencies. The final energy intensity for each technology is given by:

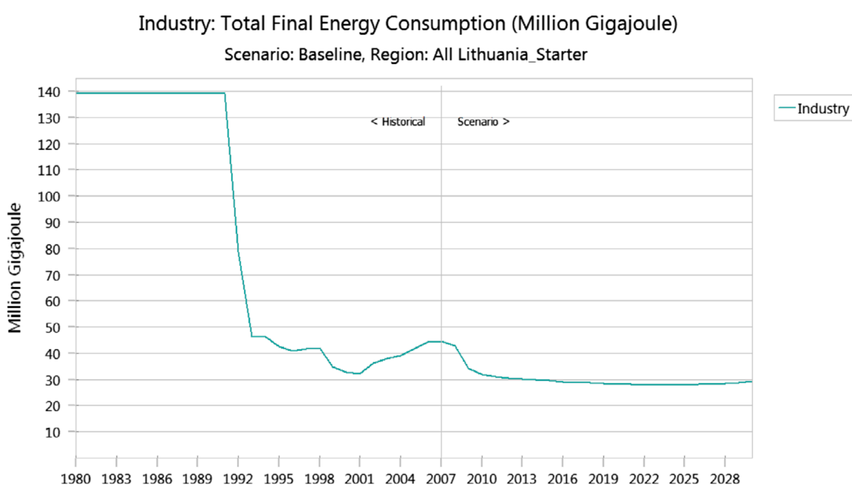


Figure 3. Total demanded energy consumption up to the year 2030.
Source: Authors' analysis.

$$EI_{b,s,t} = UI_{AGG,s,t} \times AS_{b,s,t}/EFF_{b,s,t} \tag{4}$$

Overall energy demand for each technology is calculated in the same way as for a final energy demand. In other words (Heaps, 2012):

$$D_{b,s,t} = TA_{b,s,t} \times EI_{b,s,t} \tag{5}$$

We performed modelling of value added changes, energy demand and energy intensities of all the economic sub-sectors. Generalising the obtained results we claim: economic activity of overall industry and industrial sub-sectors is going to increase. The demand for energy is going to remain stable; increase is not significance and does not represent a menacing threat to the environment (Figure 3). This result can be explained by the gradual diminishing of energy intensities in almost all economic sectors. Here we need

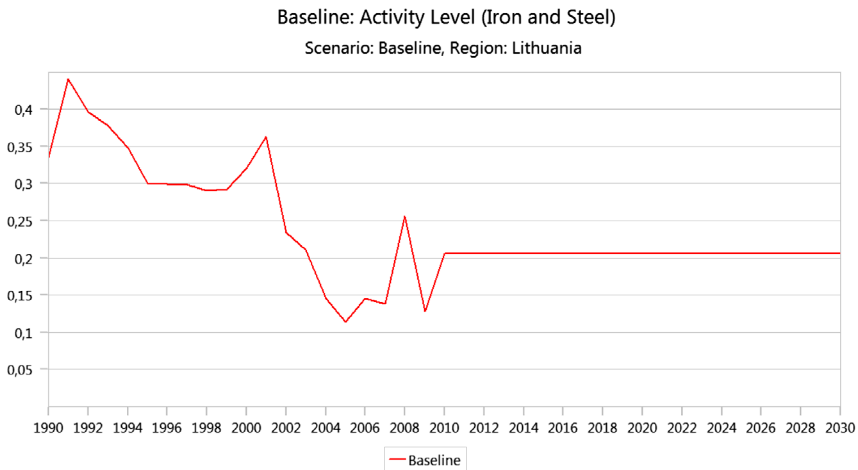


Figure 4. Development pattern of Iron and Steel industrial sub-sector (billion USD).
Source: Authors' analysis.

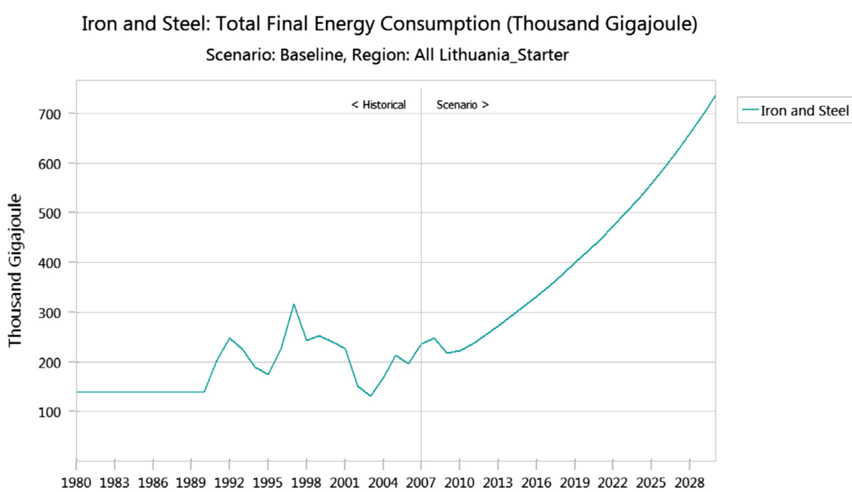


Figure 5. Pattern of energy consumption change in Iron and Steel sub-sector.\
Source: Authors' analysis.

to point out that two sub-sectors of industry demonstrate trends different from those provided here. The sub-sector of Iron and Steel is not going to expand, but is characterised by a growing energy demand and a growing energy intensity (Figures 4–6).

The respective modelling results of chemical and petrochemical, non-metallic minerals, transport equipment, machinery, food and tobacco, paper pulp and print, textiles and leather showed that the listed industries are characterised by diminishing energy intensity trends. For that reason the development of listed industries does not cause an increase in the energy demanded in the medium term period (up to the year 2030).

Meanwhile modelling results of wood and wood products (respectively Figures 7–9) provided results analogical to the results of the modelling of performance of Iron and Steel industrial sub-sector.

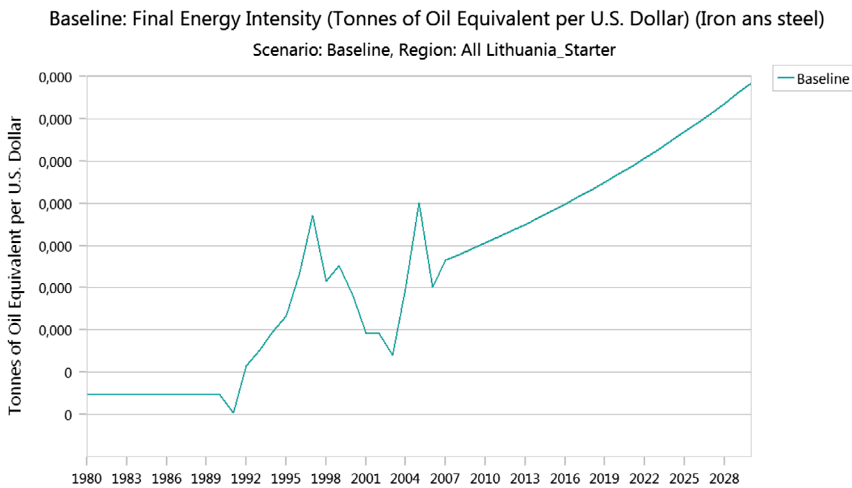


Figure 6. Energy intensity change in Iron and Steel industrial sub-sector.\
Source: Authors’ analysis.

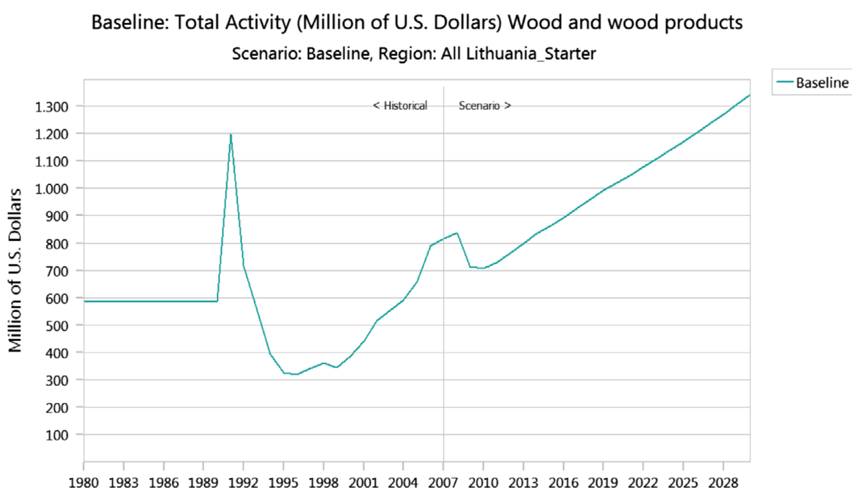
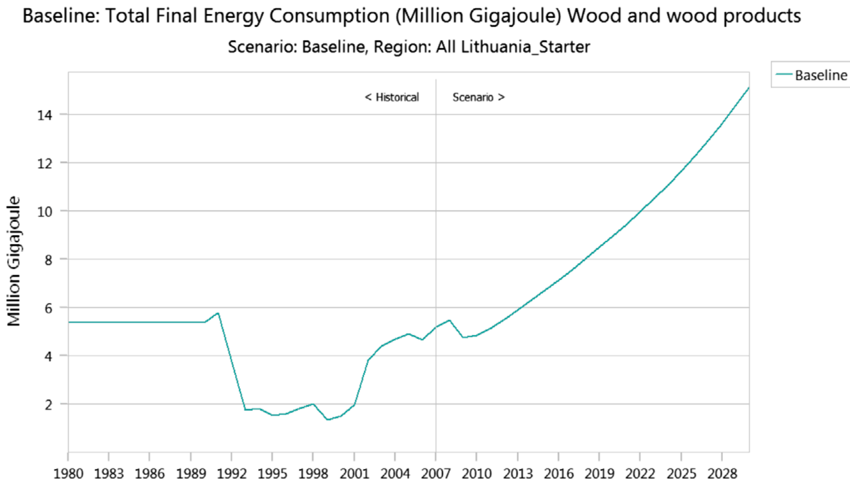


Figure 7. Development of Wood and Wood products industrial sub-sector.
Source: Authors’ analysis.



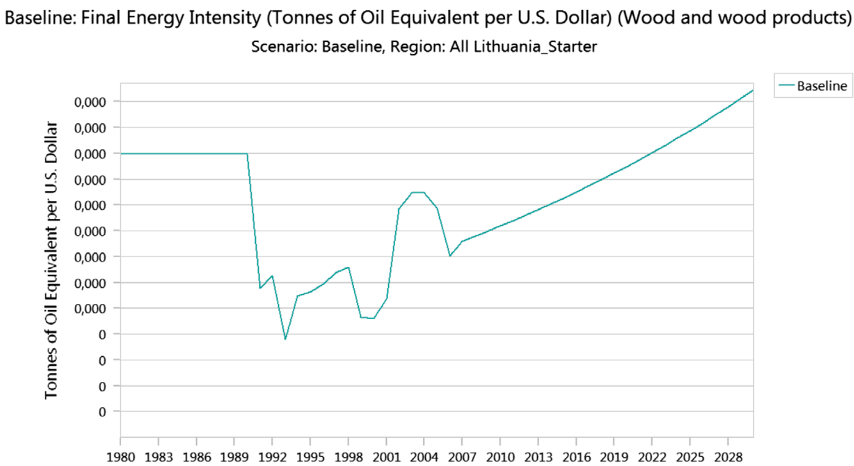


Figure 9. Energy intensity in Wood and Wood products industrial sub-sector.
Source: Authors' analysis.

3. Conclusion

To answer a major research question, if the development of industry, which requires energy resources is compatible or contradicts the goals of sustainable development and long-term competitiveness, we can make the following theoretically grounded and empirically tested conclusions.

By sustainable competitiveness of industry development we mean the ability of industry to maintain long-term ability to compete in the international market. We claim that such ability could be enhanced by gradual industry restructuring, which would be performed by taking into account forecasts of energy intensities of separate sectors of industry (Travkina & Tvaronavičienė, 2015).

Unrestricted energy availability in some specific cases can be detrimental to environment, and therefore contradict sustainable development goals. Those specific cases could emerge if industrial activities with increasing energy intensity were intensively expanded. Here we need to notice, that objective reasons for increasing energy intensity could be provided, e.g. Energy intensity of Iron and Steel industrial sub-sector naturally rise because of the skyrocketing energy intensity of iron and steel prospecting.

The same was observed with the wood and wood production industry. It involves forest cutting, which is extremely energy intensive. In case a country does not develop such specific industrial activities, we can claim, that its industry development is compatible with energetically secure sustainable development and long-term competitiveness goals. This compatibility can be achieved exclusively by adopting the newest technologies, which enable gradual and efficient reduction of energy intensity.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Ahmad, R. M., & Al Sayed, S. K. S. (2013). Environmental Kuznets curve: Evidences from developed and developing economies. *Applied Mathematical Sciences, 7*, 1081–1092.

Ala-Juusela, M., Short, M., & Shvadron, U. (2014). Tools to support sustainable entrepreneurship in energy positive neighbourhoods. *Entrepreneurship and Sustainability Issues, 2*, 49–59. doi:10.9770/jesi.2014.2.2(1)

Baikovs, A., & Zariņš, I. (2013). Philosophical, legal and general issues of legal liability. *Entrepreneurship and Sustainability Issues, 1*, 23–36. doi:10.9770/jesi.2013.1.1(3)

Balkytė, A., & Tvaronavičienė, M. (2010). Perception of competitiveness in the context of sustainable development: Facets of "Sustainable competitiveness". *Journal of Business Economics and Management, 11*, 341–365.

Baodong, L., & Xiaokun, W. (2011). Economic structure and intensity influence. *Air Pollution Model Original Energy Procedia, 5*, 803–807.

Barberis, S., Di Fresco, L., Santamaria, V. A., & Traverso, A. (2014). Sustainable entrepreneurship via energy saving: Energy harvester exploiting seebeck effect in traditional domestic boiler. *Entrepreneurship and Sustainability Issues, 2*, 86–97. doi:10.9770/jesi.2014.2.2(4)

Baublys, J., Miškinis, V., Konstantinavičiūtė, I., & Lekavičius, V. (2014). Aspirations for sustainability and global energy development trends. *Journal of Security and Sustainability Issues, 3*, 17–26. doi:10.9770/jssi.2014.3.4(2)

Baublys, J., Miškinis, V., Konstantinavičiūtė, I., & Lekavičius, V. (2015). Energy efficiency as precondition of energy security. *Journal of Security and Sustainability Issues, 4*, 197–208. doi:10.9770/jssi.2015.4.3(1)

Bilevičienė, T., & Bilevičiūtė, E. (2015). Influence of employment on strategy of sustainable development implementation. *Journal of Security and Sustainability Issues, 4*, 520–535. doi:10.9770/jssi.2015.4.3(3)S

Bilgin, M. H., Lau, C. K. M., & Tvaronavičienė, M. (2010). Is China integrated with her major trading partners: Evidence on financial and real integration. *Technological and Economic Development of Economy, 16*, 173–187.

Bistrova, J., Lace, N., & Tvaronavičienė, M. (2014). Corporate governance as a crucial factor in achieving sustainable corporate performance. *Journal of Systemics, Cybernetics and Informatics, 3*, 82–90. Retrieved from http://www.iiisci.org/journal/sci/FullText.asp?var=&id=SA718DP14

Caurkubule, Ž., & Rubanovskis, A. (2014). Sustainable entrepreneurship through motivation: Case of Latvian companies. *Entrepreneurship and Sustainability Issues, 2*, 43–48. doi:10.9770/-jesi.2.1(6)

Čiegis, R., Štreimikienė, D., & Zavadskas, E. (2008). The use of environmental Kuznets curve: Environmental and economic implications. *International Journal of Environment and Pollution, 33*, 313–335.

Ciemleja, G., Lace, N., & Titko, J. (2014). Financial literacy as a prerequisite for citizens' economic security: Development of a measurement instrument. *Journal of Security and Sustainability Issues, 4*, 29–40. doi:10.9770/jssi.2014.4.1(3)

Culas, R. (2012). REDD and forest transition: Tunnelling through the environmental Kuznets curve. *Ecological Economics, 79*, 44–51.
Cuneo, A., Ferrari, M. L., Traverso, A., & Massardo, A. F. (2014). Sustainable district development: A case of thermoeconomic optimization of an energy hub. *Entrepreneurship and Sustainability Issues, 2*, 74–85. doi:10.9770/jesi.2014.2.2(3)
Dezellus, E., Ferreira, L., Pereira, N., & Vasiliūnaitė, R. (2015). Entrepreneurship conditions: Energy resources' prices and energy consumption peculiarities in developed countries. *Entrepreneurship and Sustainability Issues, 2*, 163–170. doi:10.9770/jesi.2014.2.3(5)
Dudzevičiūtė, G. (2013). Lithuanian manufacturing trends in the context of developed and developing countries. *Entrepreneurship and Sustainability Issues, 1*, 55–66. doi:10.9770/-jesi.2013.1.1(6)
Dudzevičiūtė, G., Mačiulis, A., & Tvaronavičienė, M. (2014). Structural changes of economies: Lithuania in the global context. *Technological and Economic Development of Economy, 20*, 353–370.
Dudzevičiūtė, G., & Tvaronavičienė, M. (2011). Measurement framework of innovation activity: Theoretical approaches' analysis. *Journal of Security and Sustainability Issues, 1*, 61–73. doi:10.9770/jssi.2011.1.1(6)
Dzemyda, I., & Raudeliūnienė, J. (2014). Sustainable youth entrepreneurship in conditions of global economy toward energy security. *Entrepreneurship and Sustainability Issues, 1*, 247–256. doi:10.9770/jesi.2014.1.4(7)
Ekins, P. (1993). Limits to Growth' and 'Sustainable Development': Grappling with ecological realities. *Ecological Economics, 8*, 269–288.
Endrijaitis, R., & Alonderis, A. (2015). Towards sustainable security: Complex dynamic systems and leadership. *Journal of Security and Sustainability Issues, 4*, 279–293. doi:10.9770/jssi.2015.4.3(8)
Energy Information Administration (EIA). (2009). *World Energy Outlook*. Retrieved from http://www.worldenergyoutlook.org/media/weowebsite/2009/WEO2009.pdf
European Commission. (2010). *European Economic Forecast - Spring 2010*. Retrieved from http://ec.europa.eu/economy_finance/publications/european_economy/2010/pdf/ee-2010-2_en.pdf
Figurska, I. (2014). Sustainable entrepreneurship: Localization, acquiring and use of knowledge sources in competitive organization. *Entrepreneurship and Sustainability Issues, 1*, 210–222. doi:10.9770/jesi.2014.1.4(3)
Fosten, J., Morley, B., & Taylor, T. (2012). Dynamic misspecification in the environmental Kuznets curve: Evidence from CO2 and SO2 emissions in the United Kingdom. *Ecological Economics, 76*, 25–33.
Fujii, H., & Managi, S. (2013). Which industry is greener? An empirical study of nine industries in OECD countries. *Energy Policy, 57*, 381–388.
Garškaitė-Milvydienė, K. (2014). Anti-crisis management of enterprises and possibilities of overcoming their critical condition. *Entrepreneurship and Sustainability Issues, 1*, 187–203. doi:10.9770/jesi.2014.1.4(1)
Giriūnas, L., & Mackevičius, J. (2014). Evaluation of frauds in public sector. *Entrepreneurship and Sustainability Issues, 1*, 143–150. doi:10.9770/jesi.2014.1.3(3)
Giriūnienė, G. (2013). Public sector‘s subsidies to business – suitability valuation of labor market support measures. *Entrepreneurship and Sustainability Issues, 1*, 37–44. doi:10.9770/-jesi.2013.1.1(4)
Giriūnienė, G., & Giriūnas, L. (2015). Sustainable development and tax system: It's impact on entrepreneurship. *Journal of Security and Sustainability Issues, 4*, 233–240. doi:10.9770/jssi.2015.4.3(4)
Goyal, S., & Sergi, B. S. (2015). Social entrepreneurship and sustainability – Understanding the context and key characteristics. *Journal of Security and Sustainability Issues, 4*, 269–278. doi:10.9770/jssi.2015.4.3(7)
Grybaitė, V. (2011). Towards measurement of sustainable development: Systems of indicators. *Journal of Security and Sustainability Issues, 1*, 17–24. doi:10.9770/jssi.2011.1.1(2)
Guruz, R., & Scherer, R. (2014). Sustainable energy entrepreneurship through architectural design: A key point controlled method. *Entrepreneurship and Sustainability Issues, 2*, 60–73. doi:10.9770/jesi.2014.2.2(2)
Heaps, C. G. (2012). Long-range Energy Alternatives Planning (LEAP) system. [Software version 2014.0.1.16]. Somerville, MA, USA: Stockholm Environment Institute. Retrieved from www.energycommunity.org

Hoffmann, T., & Prause, G. (2015). How to keep open-source based innovation approaches sustainable: A view from the intellectual property perspective. *Entrepreneurship and Sustainability Issues, 2*, 133–141. doi:10.9770/jesi.2014.2.3(2)
Huang, W. M., Lee, G. W. M., & Wu, C. (2008). GHG emissions, GDP growth and the Kyoto Protocol: A revisit of Environmental Kuznets Curve hypothesis. *Energy Policy, 36*, 239–247.
Ignatavičius, R., Tvaronavičienė, M., & Piccinetti, L. (2015). Sustainable development through technology transfer networks: Case of Lithuania. *Journal of Security and Sustainability Issues, 4*, 261–267. doi:10.9770/jssi.2015.4.3(6)
Intergovernmental Panel on Climate Change (IPCC). (1997). Houghton J.T., Meira Filho L.G., Lim B., Treanton K., Mamaty I., Bonduki Y., Griggs D.J. and Callander B.A. (Eds.), *Revised 1996 IPCC Guidelines for National Greenhouse Inventories*. IPCC/OECD/IEA, Paris, France. Retrieved from http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm
Išoraitė, M. (2013). Motivation tools though lenses of prospective employees. *Entrepreneurship and Sustainability Issues, 1*, 116–123. doi:10.9770/jesi.2013.1.2(6)
Iwata, H., Okada, K., & Samreth, S. (2010). Empirical study on the Environmental Kuznets Curve for CO2 in France: The role of nuclear energy. *Energy Policy, 38*, 4057–4063.
Karnitis, E. (2011). Strategy and efficient mechanisms to improve security and sustainability of the natural gas supply in Baltic States. *Journal of Security and Sustainability Issues, 1*, 3–15. doi:10.9770/jssi.2011.1.1(1)
Lankauskienė, T. (2014). Accounting productivity in the sectors of economy: Methodological aspects. *Entrepreneurship and Sustainability Issues, 2*, 98–106. doi:10.9770/jesi.2014.2.2(5)
Lankauskienė, T., & Tvaronavičienė, M. (2011). Interrelation of countries' development level and foreign direct investment performance. *Journal of Business Economics and Management, 12*, 546–565. doi:10.3846/16111699.2011.599412
Lapinskienė, G., Tvaronavičienė, M., & Vaitkus, P. (2014). The emissions of greenhouse gases and economic growth – The evidence of the presence of the Environmental Kuznets curve in the European Union countries. *Technological and Economic Development of Economy, 20*, 65–78. doi:10.3846/20294913.2014.881434
Laužikas, M., & Krasauskas, A. (2013). Impacts of sustainable structural growth on the economic performance of listed companies. *Entrepreneurship and Sustainability Issues, 1*, 81–91. doi:10.9770/jesi.2013.1.2(2)
Laužikas, M., & Mokšeckienė, R. (2013). The role of creativity in sustainable business. *Entrepreneurship and Sustainability Issues, 1*, 10–22. doi:10.9770/jesi.2013.1(2)
Mačiulis, A., & Tvaronavičienė, M. (2013). Secure and sustainable development: Lithuania's new role in taking the Presidency of the EU. *Journal of Security and Sustainability Issues, 3*, 5–13. doi:10.9770/jssi.2013.3.2(1)
Makštutis, A., Balkytė, A., & Tumalavičius, V. (2012). Security, sustainability and competitiveness: Benchmarking attempts. *Journal of Security and Sustainability Issues, 2*, 5–12. doi:10.9770/jssi/2012.2.1(1)
Marrero, G. A. (2010). Greenhouse gas emissions, growth and the energy mix in Europe. *Energy Economics, 32*, 1356–1363.
Miškinis, V., Baublys, J., Lekavičius, V., & Morkvėnas, A. (2013). New changes in Lithuanian energy sector. *Journal of Security and Sustainability Issues, 2*, 15–28. doi:10.9770/jssi.2013.2.3(2)
Mostenska, T., & Bilan, Y. (2015). Sustainable development through enhanced social responsibility. *Journal of Security and Sustainability Issues, 4*, 536–551. doi:10.9770/jssi.2015.4.3(4)S
Peker, S., Tvaronavičienė, M., & Aktan, B. (2014). Sustainable risk management: Fuzzy approach to volatility and application on FTSE 100 index. *Entrepreneurship and Sustainability Issues, 2*, 30–36. doi:10.9770/jesi.2014.2.1(4)
Prause, G., & Hunke, K. (2014). Sustainable entrepreneurship along green corridor. *Entrepreneurship and Sustainability Issues, 1*, 124–133. doi:10.9770/jesi.2014.1.3(1)
Raudeliūnienė, J., Tvaronavičienė, M., & Dzemyda, I. (2014). Towards economic security and sustainability: Key success factors of sustainable entrepreneurship in conditions of global economy. *Journal of Security and Sustainability Issues, 3*, 71–79. doi:10.9770/jssi.2014.3.4(7)
Šabasevičienė, V., & Grybaitė, V. (2014). Main foreign direct investment factors as precondition of sustainable entrepreneurship: Evidence from Lithuania, Central and Eastern Europe. *Entrepreneurship and Sustainability Issues, 1*, 230–238. doi:10.9770/jesi.2014.1.4(5)

Saboori, S., & Sulaiman, J. (2013). Environmental degradation, economic growth and energy consumption: Evidence of the environmental Kuznets curve in Malaysia. *Energy Policy, 60*, 892–905.

Šimberová, I., Chvátalová, Z., Kocmanová, A., Hornungová, J., & Pavláková Dočekalová, M. (2015). Sustainable value in measuring of corporate sustainability: Approaches and their evaluation. *Journal of Security and Sustainability Issues, 4*, 241–259. doi:10.9770/jssi.2015.4.3(5)

Šimelytė, A., & Antanavičienė, J. (2013). Economic development and its influence on state capital structure. *Entrepreneurship and Sustainability Issues, 1*(1), 1–9. doi:10.9770/jesi.2013.1(1)

Smaliukienė, R., Dudzevičiūtė, G., Adekola, F. A., & Aktan, B. (2012). The investigation of Lithuanian industry export dependence on energetic resources. *Journal of Security and Sustainability Issues, 2*, 69–78. doi:10.9770/jssi.2012.2.2(7)

Stańczyk, J. (2011). European security and sustainability issues in the context of current international environment. *Journal of Security and Sustainability Issues, 1*, 81–90. doi:10.9770/jssi.2011.1.2(1)

Travkina, I., & Tvaronavičienė, M. (2011). Export competitiveness and domestic productivity facets: Case of Lithuania. *Journal of Business Economics and Management, 12*, 49–68.

Travkina, I., & Tvaronavičienė, M. (2015). Peculiarities of export structure in Lithuania: Synthesis and analysis. *Entrepreneurship and Sustainability Issues, 2*, 233–247. doi:10.9770/-jesi.2015.2.4(7)

Tunčikienė, Ž., & Drejeris, R. (2015). Entrepreneurship ecosystem: Methodological approaches to functions' review of public sector institutions. *Entrepreneurship and Sustainability Issues, 2*, 118–132. doi:10.9770/jesi.2014.2.3(1)

Tvaronavičienė, M. (2012). Contemporary perceptions of energy security: Policy implications. *Journal of Security and Sustainability Issues, 1*, 235–247. doi:10.9770/jssi.2012.1.4(1)

Tvaronavičienė, M. (2014). If industrial sector development is sustainable: Lithuania compared to the EU. *Entrepreneurship and Sustainability Issues, 1*, 134–142. doi:10.9770/jesi.2014.1.3(2)

Tvaronavičiene, M., Grybaite, V., & Tvaronavičiene, A. (2009). If institutional performance matters: Development comparisons of Lithuania, Latvia and Estonia. *Journal of Business Economics and Management, 10*, 271–278.

Tvaronavičienė, M., & Kalašinskaitė, K. (2010). Whether globalization in form of FDI enhances national wealth: Empirical evidence from Lithuania. *Journal of Business Economics and Management, 11*, 3–18.

Tvaronavičienė, M., Šimelytė, A., & Lace, N. (2014). Sustainable development facets: Exporting industrial sectors from inside. *Journal of Security and Sustainability Issues, 3*, 37–44. doi:10.9770/jssi.2014.3.4(4)

Tvaronavičius, V., Dudzevičiūtė, G., & Tvaronavičienė, M. (2010). *Innovation management in Lithuanian enterprises: Insight into daily practice*. 6th International Scientific Conference: Business and Management' 2010. Selected papers, Vilnius, Lithuania, May 13–14. (Vol. 1, pp. 1107–1113). ISBN 2029-4441.

United Nations Industrial Development Organization (UNIDO). (2009). INDSTAT4 (Industrial Statistics database). Retrieved from http://www.unido.org/en/resources/statistics/statistical-databases.html

Vasiliūnaitė, R. (2014). Sustainable development: Methodological approaches toward issues. *Journal of Security and Sustainability Issues, 3*, 69–75. doi:10.9770/jssi.2014.3.3(6)

Vosylius, E., Rakutis, V., & Tvaronavičienė, M. (2013). Economic growth, sustainable development and energy security interrelation. *Journal of Security and Sustainability Issues, 2*, 5–14. doi:10.9770/jssi.2013.2.3(1)

Wahl, M., & Prause, G. (2013). Toward understanding resources, competencies, and capabilities: Business model generation approach. *Entrepreneurship and Sustainability Issues, 1*, 67–80. doi:10.9770/jesi.2013.1.2(1)

World Bank. (2010). *World development indicators*. Retrieved from http://data.worldbank.org/sites/default/files/wdi-final.pdf

World Energy Council. (2007). 2007 Survey of Energy Resources. Retrieved from http://ny.whlib.ac.cn/pdf/Survey_of_Energy_Resources_2007.pdf

World Resources Institute. (2008). CAIT (Climate Analysis Indicators Tool) Database. Retrieved from http://cait.wri.org/