International Journal of Business, Human and Social Sciences
ISSN: 2517-9411
Vol:10, No:2, 2016

Impact of the Non-Energy Sectors Diversification on the Energy Dependency Mitigation: Visualization by the "IntelSymb" Software Application

Ilaha Rzayeva, Emin Alasgarov, Orkhan Karim-Zada

Abstract**—**This study attempts to consider the linkage between management and computer sciences in order to develop the software named "IntelSymb" as a demo application to prove data analysis of non-energy* fields' diversification, which will positively influence on energy dependency mitigation of countries. Afterward, we analyzed 18 years of economic fields of development (5 sectors) of 13 countries by identifying which patterns mostly prevailed and which can be dominant in the near future. To make our analysis solid and plausible, as a future work, we suggest developing a gateway or interface, which will be connected to all available on-line data bases (WB, UN, OECD, U.S. EIA) for countries' analysis by fields. Sample data consists of energy (TPES and energy import indicators) and non-energy industries' (Main Science and Technology Indicator, Internet user index, and Sales and Production indicators) statistics from 13 OECD countries over 18 years (1995-2012). Our results show that the diversification of non-energy industries can have a positive effect on energy sector dependency (energy consumption and import dependence on crude oil) deceleration. These results can provide empirical and practical support for energy and non-energy industries diversification' policies, such as the promoting of Information and Communication Technologies (ICTs), services and innovative technologies efficiency and management, in other OECD and non-OECD member states with similar energy utilization patterns and policies. Industries, including the ICT sector, generate around 4 percent of total GHG, but this is much higher — around 14 percent — if indirect energy use is included. The ICT sector itself (excluding the broadcasting sector) contributes approximately 2 percent of global GHG emissions, at just under 1 gigatonne of carbon dioxide equivalent (GtCO2eq). Ergo, this can be a good example and lesson for countries which are dependent and independent on energy, and mainly emerging oil-based economies, as well as to motivate non-energy industries diversification in order to be ready to energy crisis and to be able to face any economic crisis as well.

Keyword**—**Energy policy, energy diversification, "IntelSymb" software, renewable energy.

I. INTRODUCTION

THE challenges are facing the energy industry are growing more difficult every day. Projects and initiatives are increasing in size, complexity, risks and costs. At the same time, society is transforming and demanding more from both business and government sectors because of rapid economic development and social improvement [1], [19]. These changes create challenges and opportunities for companies in the energy industry, policymakers, and society at large. However, their rapid development can be also explained in some part of being dependent on energy which has led to energy crises (oil shock of 1970s, 1994), social conflicts (Gulf war, Libya case, Sudan war and so on), environmental issues (pollution, climate change and global warming), and energy shortage with consequences of social disturbance as well as economic instability [3], [19]. All of these factors should be addressed by states to allow not only for the implementation of energy diversification as a key element of sustainable energy policy development, but also to encourage the diversification of non-energy industries for stable economic development [7], [21]. Thus, countries should contemporaneously consider the adoption of policies aimed at multi-diversification policy, using diverse of non-energy industries, such as science and technology, production and sales, ICT development and so on.

Energy became a fashion since the last century; the last 25 years of the 20th century can be seen as a period of creative destruction; new technologies have reduced the importance of scale economies in many sectors [15], [17]. Likewise, a research of [16] said that small technology-based firms have started to challenge large companies that still had less confidence in mass production techniques [5], [25]. Supporting the idea from the OECD reports on how deregulation and privatization movements have swept the world, it becomes an utmost and ultimate goal of many economies to move and apply a new reform into lessen of energy dependency [16], [21]. For example, countries like Australia, Finland, Italy and Sweden have had strong tendencies to deregulate and privatize in many sectors of their respective economies [1], [4]. Many studies have been considering and analyzing energy development and its impact on the economy, as well as keeping in the scope of non-energy sectors' influence on economic stability and diversification. Thus, as an extension to the literature, our study's purpose claimed that the environmental Kuznets curve (EKC) hypothesis states that pollution follows an inverted U-path with respect to economic growth, also examines with regard to commercial energy consumption, the source of many serious environmental problems with stated regression analysis in (1) [10]-[14]:

$$\ln (E/P)_{it} = \alpha_i + \gamma_t + \beta_1 \ln(GDP/P)_{it} + \beta_2 (\ln(GDP/P))2_{\ it} + \varepsilon_{it} \quad (1)$$

The curve in Fig. 1 fits environmental economics theory – local impacts are internalized in a single economy or region and are likely to give rise to environmental policies to correct

Dr. Ilaha Rzayeva is ICT Policy Analyst at the Strategic Planning and Membership Department, Corporate Strategy Division, International Telecommunication Union (ITU), Geneva, Switzerland (e-mail: ilaha.rza@gmail.com).

the externalities on pollutes before such policies are applied to globally externalized problems [10], [5]. Moreover, some studies found that industrialized countries have been able to reduce their energy requirements by importing manufactured goods and that economic growth, trade, and energy are interrelated and correlated in terms of environmental and economic structural changes in developed countries [16]. Because our study considers one of the affecting and main variables of energy policy development such as trade (import/export), we can see how this study supports our research. Also, as an example of non-energy sectors diversification, countries like India, China and Turkey have improved the relationship between energy and non-energy inputs to the economy in positive way. The case of India's manufacturing industry shows how substitution of possibilities act and react among energy inputs and other (non - energy) factors of production in response to price changes [13], [22]. The changing picture of the world energy usage illustrates that economic development and environmental problems have become global issues; whereas energy consumption used to be an issue mainly for developed countries. However, it is becoming a matter of increasing international concern. Economic growth and environmental policies such as Kyoto Protocol aims for a worldwide reduction in greenhouse gas emissions (GHG), with the following the Paris COP21 Climate Change conference agreement [20]. A question appeared in a study asks if relatively energy-inefficient countries can catch up with technological "leaders" and, if so, how quickly, and by what means? By providing empirical analysis of energy-productivity convergence across 56 developed and developing countries in mix, in 10 manufacturing sectors, for the period 1971-1995, a study tested for the catch-up hypothesis using panel data confirms that in all manufacturing sectors energy productivity growth is, in general, relatively high in countries that initially lag behind in terms of energy-productivity levels [15].

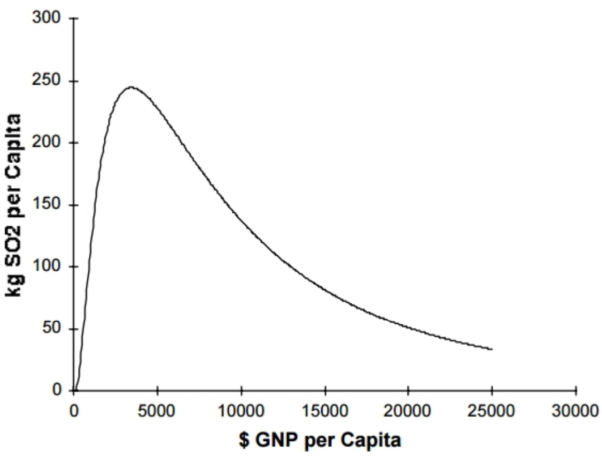

Fig. 1 Environmental Kuznets Curve for Sulfur Emissions

Energy efficiency has been, and is still an important subject of discussion at the political, economic, and technological levels. In the study case of the Netherlands using data at the 3-digit level for the Dutch manufacturing industry has analyzed the performance of the sectors with respect to its energy intensity, value added and value of production, and energy costs [24], [4]. Another paper focused on an area that has been neglected in energy analysis, the non-energy intensive industries. In order to prove if energy consumption causes economic growth, the study examines causality between energy and GDP, using a consistent data set and methodology for over 100 countries [6]. The causality from energy to GDP showed that it is more prevalent in developed OECD countries than in developing non-OECD countries. The policy implication of reducing energy consumption, which aims to reduce emissions, is likely to have greater impact on the GDP of the developed rather than the developing world [16].

The energy-economic growth nexus has been as extensively analyzed by energy economists [2]. An important policy implication also has showed that low barriers to entry and exit of businesses are necessary conditions for the equilibrium seeking mechanism that are vital for a sound economic development [5]. Authors addressed Joseph Schumpeter's contribution to the understanding of the mechanism of technological progress and economic development of 23 OECD countries in the period 1976-1996. Thus, not only energy and its heavy usage can boost the economy, but also possibly to convert it into binding constraints and vulnerable issue [9].

Today energy is one of the most important issues. It also takes number one position in all economies and by no means, stands as a unique problem for humanity that challenges us to face questions such as can wellbeing, or even happiness be identified with the highest possible amount of per capita energy consumption or will science and technology alone take us to where we need to be in the next few decades? [1], [16]. Moreover, some side-effects of energy consumption are transmitted to future generations (nuclear waste, pollution), others to the form of military costs and political interests, which burdens our society.

Quality of life is highly correlated with energy consumption during basic economic development, but, surely we can see these days, that it is almost completely uncorrelated once countries are industrialized or economically diversified. This outcome of the previous studies will be proven and empirically tested in our research's approach, main concern of which is to emphasize and promote decision which will also secure developed countries in any energy crisis is reducing demand on oil, less dependency on energy and economic diversification or industrialization. Having said so, being dependent mainly on oil and gas for a half a century, Malaysia has started its energy policy to ensure sustainable energy supply and security [19], [21]. In case of the Baltic States, authors summarized some of the results from the application of the energy indicators for sustainable development (EISD) tool that allowed the assessment of conditions and trends in relation to the goals and targets of sustainable energy development [22]. The analysis of targeted indicators of six priority areas of energy showed significantly positive trends in relation to sustainable development in the Baltic States' energy sector.

South Korea's energy-related CO_2 emissions have been increased substantially since 1990s due to an economic boom. In order to identify the cause of this increment, authors of study have employed Log Mean Divisia (LMD) index method with five energy consumption sectors and sub-sectors and defined the main cause and dominant factor among them [8]. The study concluded that economic growth and energy intensity factors were the main explanations of increasing emission in all of the sectors [11], [18], and [21]. By emphasizing the research question, the study implied valuable recommendations in supply industries of South Korea to avoid heavy reliance on coal and promote electricity from renewable energy sources and consumption more bio-fuels and LPG in transportation sector [17], [25].

This study has proposed useful perspectives on the energy security for the population in a defined area to meet its needs for energy services over medium to long term. Interestingly, the author discusses some recent approaches, and their perspectives, underlying philosophy, to measure and enhance energy service security (ESS) with special reference to the European Union, developing diversity-based indices, establish energy mix weights in TPES, and the Supply/Demand Index [11], [12].

Policy makers, researchers, NGO's and scholars have recently shown a lot of interest in energy transition, because of the promise of large jumps in environmental efficiency. Clearly, the energy sector faces serious problems, such as oil dependency, reliability, and environmental issues [19], [21]. For example, some leading European countries are successfully applying renewable energy policy which guarantees their economies to be stable and less dependent on energy. The Netherlands is one of the leading countries in energy independency and has novel renewable energy technologies and structural changes in their electricity regime from 1960 till 2004, succeed in development of stable energy policy [7], [20], [24]. However, there is a recent concern that policy should take into account multiple market failures, context, as well as apply and build the innovative and secure energy policies which includes a strong advocacy component [10], [15], and [13].

II. Data and Methodology

A. Data Analysis and Indicators Selection

Before moving to the research objective validation and data interpretation, it is necessary to shed a light to the "non-energy sectors" definition and its source of originality. Colloquially, usually non-energy sectors are accepted and understood as industries or businesses which are–either less dependent or totally independent on energy (oil and gas) [21], [14]. However, as we may know there is no sector or industry which can be totally independent on energy, unless those that moved to the renewable or alternative energy [8]-[12]. Then, why are they called 'non-energy'? It is simply not being totally dependent on gas and crude oil as a single natural resource and allowing economies to diversify and develop other sectors for a smart economic development? It should be noted that our study and research paper considers oil and gas consumption under the energy definition, i.e., our main goal is to promote the diversification of economy and adoption of (renewable) energy as well as recommend to strengthen multi-industrial policies and strategies development as a catalyst for future stable and solid economic development.

In order to commence hypotheses development, we have obtained related data from verified and international organization's sources and data banks such as the OECD data bank, the World Bank, and IEA (see Appendix I) and then grouped them according to the algorithm's function [18], [21]. Respective countries are considered as energy dependent countries, except Norway, and economically developed. They are chosen on the neutral base and no discrimination has been applied in selection process. The given numbers of countries are geographically allocated in different regions and with different economic programs of development. Unlike other studies, we have grouped different culturally and economically based countries as one group in order to see how strong intention and willingness of different countries can be one common and persistent. The difference of our research from others is that we have adhered to a logical and smart symbol-based measurement which has been converted to coding later on, and to software application development afterward. Simply speaking, we attempted to merge two directions of science like computer science and energy economics. To be more precise, in order to be able to obtain the required letter combinations for further result verification, it was decided to develop software which will allow us to analyze raw data for each of five indicators stated in this paper. Analysis of provided data required us to perform two important steps. First of all, to develop a proper database schema in order to store given data for each of 13 countries provided according to 18 years of economic progress. Secondly, it was necessary to develop a proper algorithm for efficient data retrieve and its further analysis in order to produce reliable and verified results [23], [21].

To solve the first problem and by taking into account that for every single indicator within a given country on our hands, we took raw data which are available in a form of numbers [8], [11], [27]. They were obtained throughout 18 years starting from 1995 till 2012 inclusively. The entity relationship diagram (ERD) was suggested to run a software development (Fig. 2).

The question may appear from readers is why did we choose exactly five indicators and why do we think that it can work? The answer is indicators' selection can be at any characteristic and form, and the number is unlimited. The process considered five of them at the initial stage of research in order to test them and figure out if results are plausible and compatible with hypotheses which study has developed. Moreover, according to our knowledge, it became obvious that considered indicators are main and affecting variables to the energy dependency mitigation process. Thus, our indicators' selection is as energy diversification by sources (TPES), production and sales indicators (PSI), main science and technology indicators (MSTI), internet user index (IUI) and energy import/export indicators (EIEI) [8], [17], [12], [26]. We have learned from the previous studies that dependence on energy from regions or countries creates energy security risks for dependent countries and social instability in further. Oil dependence in particular has led to war, funding of radicals, monopolization, and socio-political instability. In order to avoid and to tackle such problems, it is necessary to move to diversification policy not only in energy sector but in non-energy sectors as well to provide sustainable economic and social development. Regarding their influence on energy dependency lessen of countries, there are studies and researches have done previously which state and give a solid background of their positive effect on energy dependency mitigation [19], [21], [24].

As it can be seen from the ERD diagram (Fig. 2), table named “country” was created in order to store country names and their unique identifiers. There are only two columns available for that. The other five tables are responsible for data storage of our indicators named “tpes”, “psi”, “e_user_index”, “msti”, and “energy_import”. The table structure is same for each of them. The first column is responsible for unique identification of raw data and do not play any important role in our calculations. The “year” column within every indicator table and each of them will store corresponding raw data for a given country. According to entity relationship among the tables, “country_id” is our primary key which is stored within “country” table. Every indicator table was connected to this table by having “country_id” as a foreign key within it. MySQL database management system was used during initial steps of software development, as it assures fast and reliable data storage and manipulation with it.

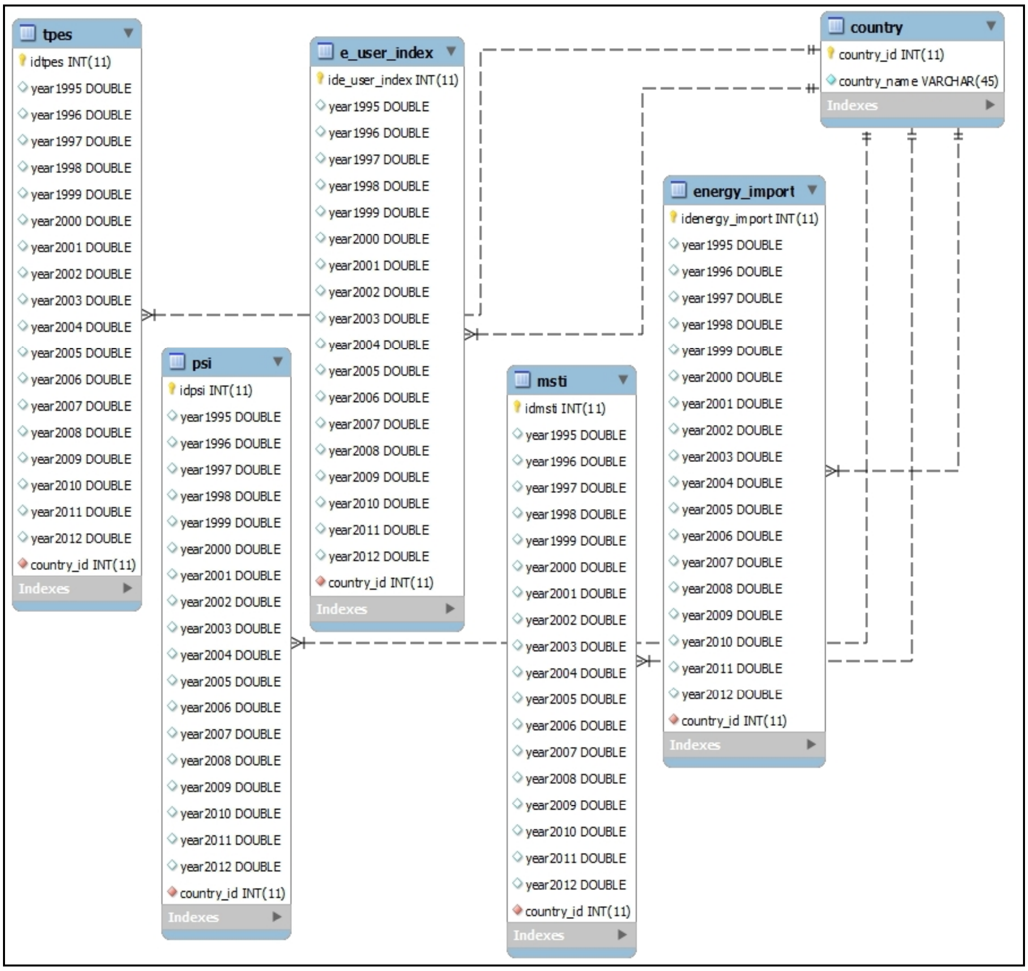

Fig. 2 ERD diagram between five patterns

These days only a few oil independent countries are able to solve their socio-economical tasks exclusively due to oil and gas exports. According to the CIA World Factbook data, the biggest problem of those countries and countries abundant with natural resources, mainly with oil, is that using those resources,-yet, they could not provide long term and scalable economic growth with high standard of living so far. However, technologically developed countries assessed priorities of development from mass industry sphere to the sphere of high technologies, science and education developments [24]. In the past decades, policymakers of those countries understood that in the modern world, intelligence became the strategic resource. Being curious and motivated by research question, we decided to analyze how countries with poor natural resources became leading countries in technological, innovation and educational developments. This also states that our patterns selection was significant and correlated with each other. To show it clearly, we can see from the comparative diagram shown on Fig. 3, that the most oil countries, despite on their high financial incomes and huge oil reservation are behind and lack in development from technologically developed countries by main socioeconomic indicators. Analyzing macroeconomic indicators of those countries demonstrates that it is possible to achieve successful economic development without natural resource abundance. Literature and relevant studies are also justified this with emphasizing on the fundaments on the base where innovative economic and information society development of the leading countries serve the high quality human resources and effective industrial economics, which smoothly transformed into innovative economics.

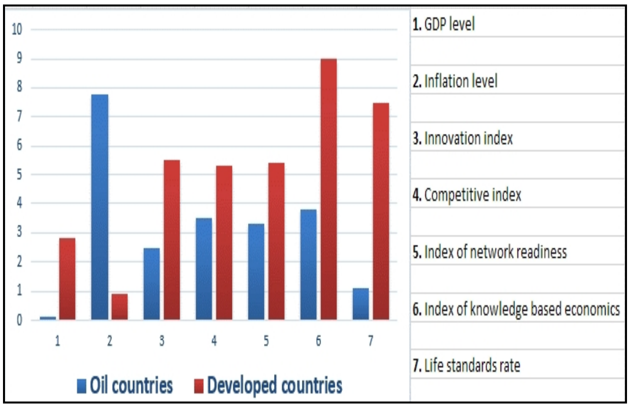

Fig. 3 Comparative diagram of socio-economic indicators of oil countries and developed countries

B.Methodology

Following to the extensive literature support to our research, we moved to the next stage of our study - to methodology implementation. The methodology which is being used in the paper has been successfully developed and implemented in the previous study but with different variables and countries such as energy import/export origins and destinations diversification [20]. This time, as a novelty and contribution to the methodology of our research as well as data collection, we have developed the "*IntelSymb*" software application, which analyzes and verifies our research questions by adding new variables of economic development which are recognized as non-energy sectors of economic development. Because of the shortage and unavailability of consistent data of many countries, our study considered only 13 OECD member countries between 1995-2012 (Appendix II, Table I) and five patterns of non-energy sectors development (Appendix II, Table II) which have been earlier described in data section of the paper.

The methodology which has been additionally utilized in software development was method is adhered to a logical and symbol-based measurement on the basis of statistics, and considered all separate patterns as an ensemble. The applied method is based on a descriptive approach; every symbol has its own interpretation and its own measure behind. They are shown as follows: A=ascending, LF=low fluctuation, F=fluctuation, D=descending, HD=high descending, L=low and N/A=not available. The above mentioned patterns' symbols of energy diversification by sources and import/export data are based on the annual data calculation of the Herfindahl–Hirschman Index (HHI) which is one of the most reliable and widely used methods of measurement for diversification [21].

Agreeably, diversification is a technique that reduces risk by allocating investments among various financial instruments, industries and other categories. It aims to maximize return by investing in different areas that would each react differently to the same event as well as reduces these economies' long-term prospects given depleting natural resource stocks.

Section II *C* will describe the next steps of software development.

C.Algorithm and Software Development

As aforementioned, for the third part of our data analysis, a proper algorithm was needed. The main focus was to retrieve one row for every single country which contains data for 18 years, store it in a form of data set and analyze it based on a certain algorithm in order to produce unique letter combinations which have been explained in the methodology part (HA – high ascending, LA – low ascending, HD – high descending, LD – low descending, HF – high fluctuating, LF – low fluctuating). In total, 6 unique letter combinations were decided to be used from the very beginning. The same procedure should be repeated for each indicator is mentioned earlier in this paper [25], [21].

During the next steps of development, it was very important to determine how we were going to measure the level of change within the available data sets. First of all, we decided to categorize our value change within a given data set by identifying whether it is on "Fluctuating" or "Ascending/ Descending" stages. This result has been achieved by comparing of every single year data in our data set with its succeeding neighbor. In case if we have too many "ups" and "downs" we treat our pattern as a "Fluctuating" one. Otherwise, in addition to comparison performed before, program compares first and last values of our data set in order to determine whether it is "Ascending" or "Descending" in general. Our main algorithm for this part of calculation was counting all "ups" and "downs" and then taking an absolute value of subtraction between those two moves. The obtained result was compared to 0.3 (30%) part of general number of comparisons (which is for n years were equal to $n-1$ comparisons). Thus, in our case, number of comparisons was equal to 17 and in order to say that taken graph is ascending (or descending), we obtained absolute value of subtraction which should be greater than 5.1 (17x0.3), otherwise, it would be considered as a fluctuating graph. Diagrams of fluctuating and ascending lines show how fluctuating graph differs from the one which is ascending (Fig. 4).

Secondly, in order to determine the speed of change (whether graph grows rapidly or slowly, or maybe fluctuating rapidly or slowly) we decided to use the concept of standard deviation from statistics and calculate the amount of dots which are contained within the borders of standard deviation and those which are contained outside of it. The standard deviation is a measure of how spread out numbers are, and according to our estimation, high spread of numbers would result in that overall change within a particular data set happens to be high, and low otherwise.

In order to work out standard deviation for a set of numbers, the square root of the variance should have been calculated by us. To do so, three important steps have been taken. First of all, an average of given values set was calculated. Then, for each value within this set, we subtract the average from it and square the result.

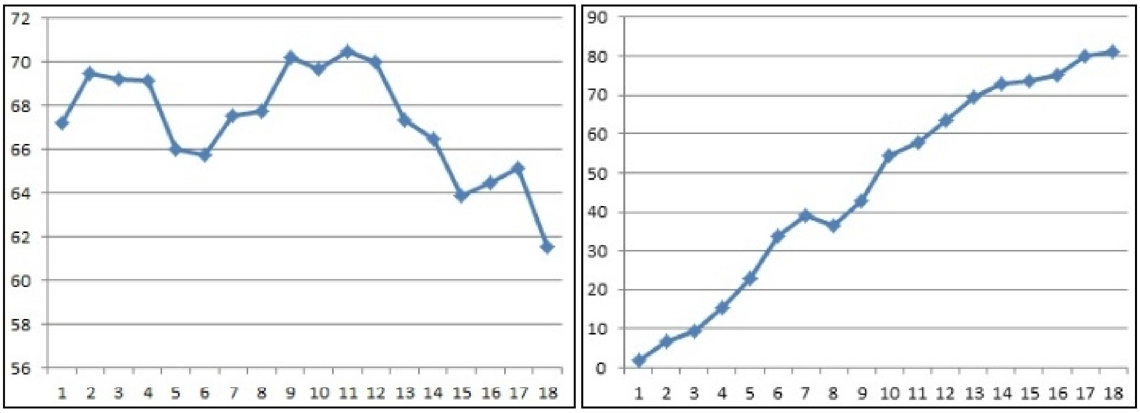

Fig. 4 Fluctuating line versus ascending line

At the final step of research, we summed up all obtained data and calculated the average mean of squared differences by dividing it to the total number of values minus one (sample standard deviation was used by us, as it was required to take one sample of data per country at a time and analyze it separately. That is why for an average calculation *n – 1* value was used instead of *n)*.

After variance calculation completion, we should square root obtained result and eventually get required standard deviation for one particular data set. All of these steps are done by program processing simultaneously in each of 5 data sets, for every country that user selects. Hereby, the main formula is:

$$s^2 = \frac{1}{N-1}\sum_{i=1}^{N}\left(x_i - avg\right)^2 \qquad (2)$$

Once again, it is said that natural resource revenues are linked to slow economic growth rates, inequality, and poverty. One culprit may be the so-called "Dutch disease", whereby resource revenues raises a country's exchange rate, hurting competitiveness in non-resource sectors. Other factors may include the volatility associated with commodity prices, which can have especially negative impacts on weak-state economies; and the underdevelopment of agricultural and manufacturing sectors during boom periods in resource-based economies. Even when oil abundance produces high growth, it often benefits only a few corrupt elites rather than translating into higher living standards for most of the population.

One might probably argue that in order to determine whether particular graph is fluctuating or ascending (or descending), and the change speed is high or low, it would be enough to look at it and came up with a certain conclusion. However, it turned out to be not a practical solution, as sometimes, visual impression might distract the observer from obtaining real and reliable result and it would be shown in Fig. 5.

The ascending line in Fig. 4 displays the change in values for South Korea from year 1995 up to the year 2012, according to “Internet users per 100 ppl-WB” indicator. By looking at this graph also, most of us will conclude that total change within this particular data set may be easily named as a High Ascending (HA). However, if we try to look at it more closely, dramatic increase in numbers could be observed only between years 1998 (point 4 at the X axis) and 2001 (point 7 at the X axis). For the rest, change in numbers is slow in comparison to those 4 years. Thus, the actual result is Low Ascending (LA). That kind of issues would not rise while using the concept of standard deviation during our calculations. Our developed software will prevent us from that kind of distracting and misleading observation, resulting in a reliable data analysis.

III. Results

It goes without saying that energy technology innovation is the key to driving the technological changes that are necessary to meet the challenge of mitigating energy-related greenhouse gas emissions and to avoid “dangerous climate change”. As an extension, we can say that in order to obtain a success in innovation development related to energy dependency lessen, it requires the enhancement of public investment in the innovation process, the creation of markets for low-carbon technologies through stronger climate policies, diversification of non-energy sectors and a continued focus on energy access and equity as well as energy policy development.

Diversification of non-energy sectors provides security in region and economic stability and "diversification is defined in a variety of ways according to the field of application. In political economy, the conceptual underpinning of this study, diversification 'normally refers to exports and specifically to policies aiming to reduce the dependence on a limited number of export commodities that may be subject to price and volume fluctuations or secular declines". Colloquially, diversification of non-energy sectors is a desirable step and an initiative for governments to move forward sustainably. Diversification ultimately promotes the effective development of sectors in a country regardless on energy dependent or independent state.

The result of our development which is shown in Fig. 4 was mainly targeted to the promotion and demonstration of the necessity to economic diversification as the way of utilizing and developing all sectors of industries equally and economies in order to avoid either economic crisis or climate change as well as to mitigate the risk of single source dependence of countries. Ergo, our developed software named as the "IntelSymb" allows us to see the apprehended scenario of non-energy sectors development by selecting the given country and its patterns with the given years. The five patterns of the case in the Republic of South Korea have almost exemplary economic diversification policy, likewise, TPES and PSI patters are highly ascending (HA), while IUI and MSTI patters are low ascending and EIEI is low fluctuating. This means that the South Korean economy and energy diversification policy are moving successfully ahead and on the way to move forward to smart or innovative economy. The IUI and MSTI patters are being in low ascending (LA) stage can be explained that South Korea ICT and R&D policy have been started to develop earlier comparatively with other countries and in the late 1990s and early 2000s South Korea is particularly well suited to success in ICT-driven economic development. This means that the Republic of Korea has both foreign and domestic markets for ICT products and services, a population with some degree of disposable income, literate citizens capable both of using and finding uses for information technologies, as well as a business community engaged in global trade and exposed to evolving ICT business practices. Access to knowledge is now a key factor in a country's economic competitiveness, and the Republic of Korea's tradition of proactive industrial policy means that the changes demanded by business deployment of ICTs are more likely to be planned for than resisted against, at least by management and policy makers.

Like the U.S. in the late 1990s, though obviously on smaller scale, South Korea became a technological leader -- especially in display systems like portable computers that could be rolled up like a newspaper and stem cell biotech innovations. Indeed, its lead in genetic engineering may become more strategic in nature, since South Korean public policy does not place limitations on biotech innovation that the United States does. Currently, Korean growth is steady with The Economist team of forecasters projecting 3.4% growth in 2013. Korea's ICT revolution was one more "miracle" and through the ICT revolution, Korea succeeded in achieving rapid economic recovery as well as social transition.

The key to Korea's miracle recovery was the emergence of a new industry based on information and communication technology (ICT), an area that had not been significant in national accounting previously [5], [21]. Consequently, starting from the 2009, ICT and S&T sectors have slow down slightly their speedy development but yet keep developing.

The EIEI pattern is still in a good positon of being low fluctuating (LF), which means that South Korea moves to alternative energy and green energy implementation with a low focus on energy (oil/gas) import/export policy. Moreover, TPES and PSI patterns results clearly state that energy diversification by sources and production/sales sectors are on paramount development which leads and assures secure and stable economic development of country.

Same scenario of prediction and clear explanation can be applied to any country with the given data set and time framework throughout this software.

A.Implications and Further Works

- In order to improve our approach, future research will be concentrated on data science methodologies with relevant variables.
- In particular, supervised learning (classification) and unsupervised (clustering) algorithms will be explored in order to make current work even more solid.
- In addition, in order to tackle the scalability issues, data aggregation and processing pipeline will be developed in order to facilitate larger number of datasets (increasing number of countries, indicators, years).
- Generation of online web storage for a convenient data accessibility by the parties on an interest.

Thus, our research questions and hypotheses can be accepted on the base of our proved findings:

H1: Diversification of non-energy industries have positive effect on energy sector dependency deceleration of country.

H2: Less concentration on energy (oil and gas) and more focus on innovation, ICTs, and science development policies can lead to the secure and stable economic development of countries.

Hereby, the results of the "IntelSymb" software application have clearly proved that our hypotheses are supported by results of the programming. However, further study requires more consideration of other import and export countries' data and a comparison of the results between energy dependent and independent countries in order to draw a general conclusion regarding the overall effects of diversification and their energy policy development as a response to energy crises. This software application is expected to be expanded widely in the next studies and research with extended periods, including more variables and macroeconomic factors of consideration.

IV. Conclusion

The fight against energy crisis and global climate change ranks high on the international political agenda. In the half of century, there has been increasing pressure to protect and conserve the Earth and its resources both for present and for future generations. The widest reaching international agreement aimed at reducing GHG emissions is the United Nations Framework Convention on Climate Change (UNFCCC) of 1992. According to the United Nations Conference on Trade and Development (UNCTAD), substantive research and investigations on climate change and emphasize the necessity of the movement to green energy topics. Developing countries are confronted with two major challenges in responding to climate change mitigation and moving towards a low-carbon economy: first, mobilization of the necessary finance and investment; and second, generation and dissemination of relevant technology. Our study has considered the second challenge with correlation to the first requirement. Policymakers can help investors to overcome entry barriers by requiring regulated, monopoly providers to provide access to and purchase power from power suppliers that use low-carbon sources of energy on financially attractive terms. Policies could also be designed to encourage the use of advanced, innovative and less polluting technologies and imposing taxes or other charges on GHG emissions or fossils fuel use. As with other sectors of the economy, the ICT sector faces a moral challenge to change the way it does business in order to contribute to the wider global struggle to ensure the health of our future environment.

Fig. 5 Final scenario of program processing

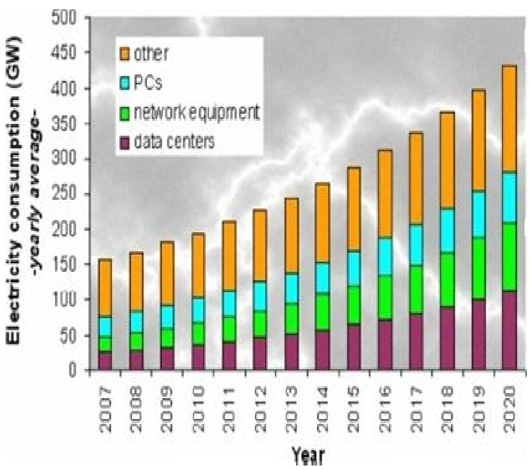

Fig. 6 ICTs impact on climate change and GHG

Renewable energy facilities must be developed in a way that effectively balances land conservation priorities and best protects wildlife and their habitats.

Governments, primarily those at the national level, set the rules for the markets in which investors seek profits. These policies often involve incentives and subsidies which could be costly and should be weighed against public expenditures in other priority areas, especially in developing countries.

As the specialized agency of the United Nations for telecommunications and ICTs, the International Telecommunication Union (ITU), its Membership, and partners are already responding to this challenge and are motivated to promote a greener ICT sector and the use of ICTs to mitigate climate change. Due to the contribution of ICTs to greenhouse gases mitigation (Fig. 6), ITU is raising awareness on the importance of incorporating energy efficiency criteria in ICT technical standards, so that the average consumption per device is reduced. In addition, ITU promotes the development of relevant policies and resolutions in green ICTs. However, the actions of the ICT industry have to be a coordinated part of a wider global initiative. Therefore, technology-based solutions have to be backed up by political will and a genuine desire to change the direction in which humanity is heading in order to avoid a planetary crisis caused by climate change and improper usage of energy [12], [21], and [23].

Worldwide concern about global warming and local demands to reduce the negative environment impacts of human activity have reached a critical mass for widespread demand of low-carbon products and processes.

The official policy and regulatory framework is only one of the elements that contribute to greening world community financial system. The reforms, policies, frameworks and initiatives identify a broad "ecosystem" of commercial, public sector and nonprofit actors who have played a key role in fostering the articulation of sustainability issues across the financial sector. The recent COP 21 event in Paris once again proved that the world community must consider the implications of stable renewable energy policies and reforms, as well as cooperate and collaborate for a more sustainable future.

A clear investment promotion position on long term relationship-building from the outset will reassure new investors, help Governments fine-tune its policies for maximum impact, and help both stakeholders to identify and convert opportunities for low carbon economic growth.

APPENDIX I

TABLE I
ENERGY IMPORTS, NET (% OF ENERGY USE) OF 13 OECD COUNTRIES FROM 1995-2012 YEARS [17]

Years	Norway	UK	Australia	Austria	Belgium	Finland	Germany	Greece	Japan	Korea	USA	Canada	Denmark
1995	-686.292	-19.082	-101.9227	67.247	77.802	54.4969	56.9018	58.999	80.138	85.390	19.736	-51.1682	19.613744
1996	-811.303	-19.223	-91.77466	69.512	78.223	56.237	58.8115	61.031	79.939	85.700	20.578	-51.7789	19.505736
1997	-783.427	-22.361	-98.45492	69.201	76.407	53.3833	58.3625	60.713	79.275	86.141	21.509	-52.8326	0.4611086
1998	-719.141	-22.764	-108.2853	69.123	77.301	58.278	60.3288	61.625	78.313	82.680	21.569	-54.1281	1.8933806
1999	-695.914	-26.817	-101.0894	66.004	76.097	52.5476	59.0461	62.932	79.592	82.277	24.457	-49.1632	24.049016
2000	-770.795	-22.219	-116.0325	65.751	76.526	53.7956	59.7913	63.132	79.605	81.694	26.659	-48.2231	48.843327
2001	-742.763	-17.238	-135.6264	67.551	77.18	53.753	61.1449	64.416	79.483	81.709	24.304	-52.0821	41.319941
2002	-842.434	-18.302	-132.1059	67.72	76.058	53.8669	60.2667	63.882	81.005	82.434	26.604	-54.73	50.421485
2003	-767.56	-10.967	-127.782	70.19	76.879	56.7572	59.8129	66.010	83.388	81.256	27.723	-47.3766	41.736923
2004	-763.859	-1.7249	-125.5547	69.662	76.657	57.3423	59.3612	65.327	81.795	81.602	28.697	-48.6662	60.111023
2005	-735.839	7.85721	-133.6152	70.514	76.304	51.399	59.3509	65.899	80.686	79.549	29.661	-47.3399	65.740761
2006	-692.699	14.7056	-131.7645	69.99	76.302	51.3221	59.1616	66.690	80.483	79.506	27.967	-53.0159	45.905769
2007	-680.163	16.5307	-138.0616	67.374	74.8	56.1956	57.2987	66.338	82.409	80.821	28.585	-53.1258	37.034051
2008	-634.747	19.9767	-130.585	66.514	75.179	53.3141	59.1913	67.577	82.095	80.290	25.262	-53.1239	-38.78969
2009	-620.996	19.321	-137.9545	63.88	73.173	50.3478	58.8162	65.756	80.098	80.664	22.112	-55.2505	30.510428
2010	-529.149	26.5074	-151.8714	64.45	73.658	52.3663	59.7773	65.797	80.060	82.028	22.211	-57.7628	20.676752
2011	-594.297	31.1241	-141.4611	65.155	69.184	50.8308	60.1648	64.056	88.803	81.958	18.547	-62.4128	16.751288
2012	-577.453	39.303	-135.406	61.556	71.279	48.7993	59.8823	61.059	93.975	82.019	15.043	-66.1616	16.938622

TABLE II
TOTAL PRIMARY ENERGY SUPPLY (TPES) OF 13 OECD COUNTRIES FROM 1995-2012 YEARS ENERGY DIVERSIFICATION INDEX BY HHI [11]

Years	UK	Australia	Austria	Belgium	Finland	Germany	Greece	Japan	Korea	USA	Canada	Denmark
1995	212.2	86.7	25.3	51.2	27.1	338.2	22.1	454.5	110.9	1 969.4	8 932	18.4
1996	214.3	91.2	25.6	50.0	28.5	335.0	21.9	457.6	124.4	2 003.9	9 225	18.9
1997	215.8	91.3	25.5	52.9	30.4	333.4	22.5	483.3	132.1	2 041.1	9 550	19.6
1998	216.3	92.6	26.7	53.8	28.9	337.1	22.7	496.2	144.8	2 067.2	9 662	19.4
1999	225.6	98.9	28.4	56.7	31.1	348.4	23.4	507.1	157.3	2 113.1	9 885	21.9
2000	219.3	101.3	28.2	56.8	32.3	345.4	24.3	512.5	171.2	2 134.5	10 001	20.3
2001	221.5	103.9	28.7	57.7	32.6	343.3	25.6	503.3	156.3	2 152.7	9 926	20.0
2002	222.0	106.2	28.6	58.2	32.5	335.6	25.7	512.3	172.9	2 210.9	10 229	19.2
2003	222.9	108.1	28.6	58.5	32.3	337.3	27.1	518.9	188.1	2 273.3	10 528	18.6
2004	223.8	106.8	30.3	58.4	33.0	347.4	28.0	510.8	191.0	2 230.8	10 378	19.2
2005	218.5	111.5	30.6	56.4	34.8	339.3	28.3	510.4	198.6	2 256.0	10 392	19.0
2006	222.2	113.1	32.3	59.2	36.9	342.1	29.1	506.2	202.6	2 261.2	10 971	20.1
2007	221.9	113.7	32.5	58.9	37.1	343.5	29.7	522.5	208.2	2 307.8	11 205	19.4
2008	222.4	119.6	34.0	58.7	34.2	338.7	30.2	520.5	210.1	2 318.9	11 397	18.9
2009	219.0	122.3	33.8	58.1	37.3	341.2	30.2	519.8	213.5	2 296.7	11 242	20.3
2010	210.3	124.9	33.3	57.0	36.8	331.8	30.2	515.2	222.1	2 337.0	11 388	19.8
2011	208.1	129.4	33.5	58.6	35.3	334.7	30.4	495.5	226.9	2 277.0	11 160	19.2
2012	196.8	131.1	31.7	57.2	33.2	318.5	29.4	472.0	229.2	2 162.9	10 639	18.6

TABLE III
MAIN SCIENCE AND TECHNOLOGY INDICATORS (MSTI) OF 13 OECD COUNTRIES FROM 1995-2012 YEARS [17]

Years	Norway	UK	Australia	Austria	Belgium	Finland	Germany	Greece	Japan	Korea	USA	Canada	Denmark
1995	1.68613	1.875634	.. N/A	1.54563	1.66758	2.26139	2.188813	0.4378	2.87184	2.30453	2.4018	1.6971	1.81875
1996	.. N/A	1.800973	1.57858	1.59811	1.7645	2.52559	2.195651	.. N/A	2.76501	2.35991	2.4418	1.6509	1.83798
1997	1.62505	1.733647	.. N/A	1.69444	1.83103	2.70524	2.240871	0.4562	2.82761	2.40677	2.4709	1.658	1.92353
1998	.. N/A	1.732040	1.43489	1.77156	1.85932	2.87617	2.278376	.. N/A	2.9602	2.26267	2.4968	1.7583	2.04476
1999	1.638042	1.8040222	.. N/A	1.887824	1.93301	3.171001	2.409296	0.6081	2.97734	2.17152	2.5404	1.7952	2.17682
2000	.. N/A	1.794884	1.47364	1.932461	1.96559	3.345517	2.472234	.. N/A	3.00169	2.2957	2.6193	1.9094	.. N/A
2001	1.590468	1.7723595	.. N/A	2.05092	2.06825	3.316164	2.474047	0.5868	3.07448	2.47316	2.6375	2.0877	2.38718
2002	1.660242	1.7779401	1.64952	2.124124	1.93609	3.362687	2.502755	.. N/A	3.11562	2.40446	2.5491	2.0415	2.5082
2003	1.709288	1.7324932	.. N/A	2.24092	1.87482	3.439142	2.539627	0.5723	3.14388	2.48577	2.5525	2.0352	2.57549
2004	1.570773	1.6693021	1.73388	2.23663	1.85508	3.450158	2.503388	0.5564	3.1332	2.68298	2.4895	2.0667	2.48487
2005	1.505906	1.6981648	.. N/A	2.458704	1.82957	3.476932	2.505801	0.5975	3.3087	2.79176	2.5057	2.0397	2.45645
2006	1.479016	1.7194066	2.01026	2.439284	1.85884	3.47552	2.540261	0.586	3.4091	3.00918	2.5497	2.0049	2.47752
2007	1.594237	1.7506149	.. N/A	2.506321	1.89299	3.471429	2.531685	0.6012	3.46142	3.21035	2.6264	1.9634	2.58008
2008	1.583127	1.7537608	2.25618	2.669572	1.96686	3.700701	2.689447	.. N/A	3.46706	3.3609	2.7665	1.9182	2.8499
2009	1.758132	1.8247741	.. N/A	2.707815	2.02668	3.938342	2.82263	.. N/A	3.35734	3.56124	2.8159	1.9705	3.16039
2010	1.680607	1.774484	2.19602	2.798462	2.10478	3.900596	2.803519	.. N/A	3.25394	3.73781	2.7383	1.8601	3.00138
2011	1.65191	1.7814458	.. N/A	2.765781	2.21281	3.796766	2.892858	0.6671	3.38807	4.03919	2.7626	1.785	2.97599
2012	1.654736	1.7210832	.. N/A	2.836389	2.23621	3.548231	2.919104	0.6904	3.34185	4.3577	2.792	1.728	2.98416

TABLE IV
PRODUCTION AND SALES INDICATORS (PSI) OF 13 OECD COUNTRIES FROM 1995-2012 YEARS [17]

Years	Norway	UK	Australia	Austria	Belgium	Finland	Germany	Greece	Japan	Korea	USA	Canada	Denmark
1995	106.297	105.3	71.335	57.6414	63.4602	66.667	78.1351	96.9692	99.6024	34.4051	79.2085	86.9364	94.48592
1996	112.035	106.8	74.335	58.2082	63.7867	68.825	78.2991	97.8467	101.935	37.3573	82.7311	87.97	95.7682
1997	115.861	109.6	75.2524	61.911	66.7612	74.317	80.7217	99.7134	105.537	39.1759	88.6996	92.9342	100.3866
1998	114.639	110.9	77.338	66.9231	69.0154	79.675	83.681	108.641	98.623	36.6813	93.8474	96.1808	103.3436
1999	114.267	112.2	78.0737	70.9301	69.6321	83.675	84.6575	110.744	98.936	45.6697	97.8733	101.833	103.5794
2000	118.625	114.2	82.8195	77.3781	70.8873	91.225	89.4282	118.739	104.318	53.385	101.797	110.624	110.4149
2001	117.773	112.4	83.7289	79.7275	74.3848	91.825	89.7552	116.574	97.7189	53.6918	98.309	106.17	112.5979
2002	116.695	110.8	85.7439	80.2642	74.9073	93.933	88.7576	117.52	96.6148	58.0043	98.5193	107.845	114.131
2003	113.801	110.1	85.8757	81.8977	76.7731	94.567	89.0258	117.899	99.8529	61.2115	99.7321	107.946	114.0727
2004	113.479	110.9	86.668	87.0006	82.4157	99.942	91.7421	119.017	104.591	67.5733	102.073	109.722	112.8229
2005	113.498	110	88.4482	90.7409	85.3615	100.04	95.2632	118.087	106.084	71.8503	105.382	111.864	116.2806
2006	111.02	110.3	90.3043	97.7773	90.5908	109.63	101.098	118.829	110.689	77.8923	107.694	111.214	119.6967
2007	109.714	110.7	93.5181	103.266	96.4416	114.68	108.099	121.184	113.774	83.2816	110.386	110.307	116.7889
2008	110.244	107.5	96.2143	105.262	100.217	115.57	108.325	117.607	110.133	86.0838	106.658	107.167	115.0558
2009	105.912	97.23	95.3663	93.5311	90.0391	94.65	89.5708	106.196	86.9761	85.976	94.624	95.3963	98.25029
2010	100	100	100	100	100	100	100	100	100	100	100	100	100
2011	95.0435	98.84	100.851	106.134	104.358	101.7	108.727	92.178	97.0752	105.958	103.362	103.893	101.8247
2012	96.7083	96.46	105.73	107.459	100.983	99.592	108.107	89.1004	97.7085	107.425	107.121	104.916	101.858

TABLE V
INTERNET USERS PER 100 PPL OF 13 OECD COUNTRIES FROM 1995-2012 YEARS [17]

Years	Norway	UK	Australia	Austria	Belgium	Finland	Germany	Greece	Japan	Korea	USA	Canada	Denmark
1995	6.42322	1.8952	2.75965	1.890211	0.991663	13.9003	1.837738	0.74962	1.5944	0.8197	9.237	4.1635	3.825656
1996	18.2503	4.1237	3.27525	6.909162	2.9684116	16.7801	3.054805	1.39536	4.373	1.6242	16.42	6.7602	5.714988
1997	20.4179	7.3854	16.3694	9.533974	4.9380809	19.4587	6.711087	1.84963	9.1631	3.6008	21.62	15.072	11.382
1998	22.5601	13.67	30.8132	15.42122	7.8866227	25.4525	9.877852	3.22182	13.414	6.7818	30.09	24.897	22.66875
1999	40	21.294	40.7838	23.04432	13.772214	32.2951	20.84598	6.87729	21.391	23.552	35.85	36.186	30.59204
2000	52	26.822	46.7561	33.73013	29.431692	37.2485	30.21635	9.13884	29.991	44.7	43.08	51.3	39.17243
2001	64	33.481	52.6893	39.18545	31.288396	43.1054	31.65094	10.935	38.532	56.6	49.08	60.2	42.95752
2002	72.84	56.48	N/A	36.56	46.33	62.43	48.82	14.67	46.594	59.4	58.79	61.593	64.25
2003	78.13	64.82	N/A	42.7	49.97	69.22	55.9	17.8	48.435	65.5	61.7	64.2	76.26
2004	77.69	65.61	N/A	54.28	53.86	72.39	64.73	21.42	62.394	72.7	64.76	65.956	80.93
2005	81.99	70	63	58	55.82	74.48	68.71	24	66.921	73.5	67.97	71.66	82.74
2006	82.55	68.82	66	63.6	59.72	79.66	72.16	32.25	68.685	78.1	68.93	72.4	86.65
2007	86.93	75.09	69.45	69.37	64.44	80.78	75.16	35.88	74.3	78.8	75	73.2	85.03
2008	90.57	78.39	71.67	72.87	66	83.67	78	38.2	75.4	81	74	76.7	85.02
2009	92.08	83.56	74.25	73.45	70	82.49	79	42.4	78	81.6	71	80.3	86.84
2010	93.39	85	76	75.17	75	86.89	82	44.4	78.21	83.7	74	80.3	88.72
2011	93.97	86.84	79.5	79.8	78	89.37	83	53	79.055	83.8	77.86	83	90
2012	95	87.016	82.3495	81	82	91	84	56	79.05	84.1	81.03	86.766	93

APPENDIX II

TABLE VI
THE LIST OF COUNTRIES ARE APPLIED FOR ANALYSIS

The number of country	The name of OECD member country
1	Australia
2	Austria,
3	Belgium
4	Canada
5	Denmark
6	Finland
7	Germany
8	Greece
9	Japan
10	Korea
11	Norway
12	UK
13	USA

TABLE VII
THE LIST OF PATTERNS OF NON-ENERGY SECTORS USED FOR ANALYSIS, 1995-2012

The number of pattern	The name of pattern	Data source
1	Energy imports, net (% of energy use)	OECD data bank
2	Total Primary Energy Supply (TPES)	International Energy Agency data portal
3	Main Science and Technology Indicators	OECD data bank
4	Production and Sales Indicators	OECD data bank
5	Internet users per 100 ppl	The World Data Bank

ACKNOWLEDGMENT

The author of this paper would like to thank Professor Duk Hee Lee (KAIST) for his immense contribution to the methodology and hypotheses development of the research, and Dr. Marco Fugazza (UNCTAD) for comments that greatly improved the manuscript as well as Loyce Witherspoon, B.A in International Development and Political Science, for professionally proof editing the paper.

This paper is the result of the analysis and development carried out by the author. The views expressed are those of the author. They do not necessarily reflect those of ITU and do not engage ITU. The terms employed and the presentation of material do not imply the expression of any opinion in the part of ITU.

REFERENCES

[1] Armaroli, N., & Balzani, V. (2007). The future of energy supply: Challenges and opportunities. *Angewandte Chemie (International Ed. in English)*, *46*(1-2), 52–66.

[2] Associates, E. C. (2014). Correlation and causation between energy development and economic growth. *Economic Consulting Associates*.

[3] Avato, P., & Coony, J. (2008). *Accelerating Clean Energy Development, and Deployment: Lessons from non-energy sectors* (No. 138), p. 72. Washington D.C.: The World Bank.

[4] C. A. Ramirez, M. Patel, K. B. (2005). The non-energy intensive manufacturing sector. An energy analysis relating to the Netherlands. *Energy*, *30* (Elsevier Ltd.,), 749–767.

[5] Carree, M., Thurik, R., & Wennekers, S. (2002). Economic Development and Business Ownership: An Analysis Using Data of 23 OECD Countries in the Period 1976 – 1996. *Small Business Economics*, *19*, 271–290.

[6] Chontanawat, J., Hunt, L. C., & Pierse, R. (2008). Does energy consumption cause economic growth? Evidence from a systematic study of over 100 countries. *Journal of Policy Modeling*, *30*(2), 209–220.

[7] Duk Hee Lee, Dong Suk Kang, Ilaha Rzayeva, J. J. R. (2016). Effects of energy diverstification policy against crude oil price fluctuations. *Energy Sources, Part B: Economics, Planning, and Policy*, (SCI. Quaterly. 37-49), 1–18.

[8] Energy Information Administration, Energy Sources, Technologies, and Impacts, Paris, France, 2001.

[9] Grübler, A., & Messner, S. (1998). Technological change and the timing of mitigation measures. *Energy Economics*, *20*(5-6), 495–512.

[10] Helm, D. (2002). Energy policy: security of supply, sustainability and competition. *Energy Policy*, *30*(3), 173–184.

[11] IEA. (2010). The *World Energy Outlook*. 9 rue de la Fédération 75739 Paris Cedex 15, France.

[12] Tim Kelly and Martin Adolph, ITU-T Initiatives on Climate Change, IEEEXplore, IEEE Communications Magazine, 0163-6804/08/25.00 2008 IEEE, pp 108-114.

[13] Jansen, J. C., & Seebregts, A. J. (2010). Long-term energy services security: What is it and how can it be measured and valued? *Energy Policy*, *38*(4), 1654–1664.

[14] Laumas, M. W. and P. (1981). The Relation Between Energy and Non-Energy Inputs in India"s Manufacturing Industries. *The Journal of Industrial Economics*, *30* (2), 113–122.

[15] Martin Hvidt. (2013). Economic Diversification in GCC Countries: Past Record and Future Trends. *Kuwait Programme on Development, Governance and Globalisation in the Gulf States*, *27*(The London School of Economics and Political Science), 55.

[16] Miketa, A., & Mulder, P. (2005). Energy productivity across developed and developing countries in 10 manufacturing sectors: Patterns of growth and convergence. *Energy Economics*, *27*(3), 429–453. 2005.01.004.

[17] OECD. (1995). *Recommendation of the council of the oecd on improving the quality of government regulatioN*. Paris.

[18] Oh, I., Wehrmeyer, W., & Mulugetta, Y. (2010). Decomposition analysis and mitigation strategies of CO2 emissions from energy consumption in South Korea. *Energy Policy*, *38*(1), 364–377.

[19] Oh, T. H., Pang, S. Y., & Chua, S. C. (2010). Energy policy and alternative energy in Malaysia: Issues and challenges for sustainable growth. *Renewable and Sustainable Energy Reviews*, *14*(4), 1241–1252., 2009.12.003

[20] Peter, J and Max Corden, W. (1982). Booming sector and de-industrialization in a small opne economy. *The Economic Journal*, *368*(May 2014), pp.825–848.

[21] Rzayeva, Ilaha, Lee, Dukhee, & Rho, Jaejeung. (2014). Analysis of countries' policy change to energy crisis. *International Journal of Smart Grid and Clean Energy*, *Vol 3*(Num. 3), 354–365.

[22] Streimikiene, D., Ciegis, R., & Grundey, D. (2007). Energy indicators for sustainable development in the Baltic States. *Renewable and Sustainable Energy Reviews, 11(*5), 877–893.

[23] Surana, K. (2014). Reference Module in Earth Systems and Environmental Sciences. 79 John F. Kennedy Street, Cambridge, MA

02138: Belfer Center for science and international affairs, Harvard University.
[24] Suri, V., & Chapman, D. (1998). Economic growth, trade and energy: implications for the environmental Kuznets curve. *Ecological Economics*, *25*(2), 195–208.
[25] Verbong, G., & Geels, F. (2007). The ongoing energy transition: Lessons from a socio-technical, multi-level analysis of the Dutch electricity system (1960–2004). *Energy Policy*, *35*(2), 1025–1037.
[26] Ward, D., & Zurbruegg, R. (2000). Economic Growth? Does Insurance Evidence from. *The Journal of Risk and Insurance*, *Vol. 67* (ARIA, American Risk and Insurance Association), pp.489–506.
[27] World data bank, The World Bank (2016). Indicators of the Internet usage for OECD countries.