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The competitiveness of energy-intensive industries in EU's last members

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ABSTRACT

Purpose: Despite the success in achieving the objectives for the use of renewable energy sources, the European Union's (EU's) competitiveness is not at the desired level. In particular, the largest decreases in fossil-type energy intensity were observed in last 13 members of EU. However, it is important to trace how these countries protect the competitiveness of their energy-intensive industries.

Design/methodology/approach: The study uses Revealed Comparative Advantage (RCA) indices to measure the comparative advantage of EU-13 in energy-intensive industries for the period 1995–2014 and assesses these indicies in the framework of EU's climate policy.

Findings: Some policies which make industries to adapt EU's 20-20-20 targets, are forcing industries. In order to compete, these industries are leaving Europe and looking elsewhere. In this study we found that, particulary chemicals and non-metallic mineral manufactures resulted in a weakening of their CA over

the years in some of these members. Similarly it is found that the RCA indices of iron and steel and non-ferrous metals are decreasing.

Originality/value: study addresses the EU-13's position in terms of their competitiveness and find the connection with the EU's climate policy through their RCA of energy-intensive industries.

***Keywords*:** European Union; EU; energy-intensive; industries; climate policy; energy policy; Revealed Comparative Advantage; RCA.

INTRODUCTION

Global warming has been an important issue for a long time. It is clear that unlimited burning of fossil fuels is the cause of this agenda. Therefore, in an attempt to address this phenomenon many countries try to reduce the consumption of fossil fuels. In other words, polluted industries that use fossil fuels are under the spotlight. Despite the above common belief, there is still no consensus about the relationship between policy implications on most energy-intensive industries (i.e. dirty industries) and their comparative advantage. In the literature some empirical studies find strong evidences on positive relationship between polluted and energy-intensive industries and their competitiveness while some studies do not find any meaningful relationship. For example, Tobey (1990) did not find any statistically significant relation between net exports of each country's dirty industries and the level of stringency of a country's environmental policies. After a decade, according to European Commission Staff Working Paper (2014) called as 'Helping Firms Grow', energy intensity is negatively but insignificantly related to exports. On the other hand, in Low and Yeats (1992) tested the relationship between pollution-intensive products and Revealed Comparative Advantage (RCA) for 109 countries during the period of 1965–1988. They found an increase in RCA of dirty industries in developing countries (in Eastern Europe, Latin America and West Asia) as the Pollution Haven Hypothesis (PHH) argues. In a similar way, Abimanyu (1996) also found dirty industry expansion in developing countries using RCA analysis. However, Cole et al. (2005) showed that US (as a developed country) RCA in polluting sectors is neither lower, nor falling more rapidly than in any other manufacturing sector. So they argued that polluting industries have special characteristics such as using specific physical and human capital and these characteristics makes developing countries less attractive as a motive for resettlement. Finally, Lehr and Maxwell (2000) pose a question about whether traditional comparative advantage may lead to increased global pollution or not. Based on their findings, it is clear that pollution preferences matter in determining the overall impact of trade on pollution.

So in this study the question is whether the competitiveness of the so-called dirty industries of European Union's (EU's) last new members, increase or not while their fossil fuel consumption changes. Following this short introduction, first we present the general picture of EU's last new members' (hereafter EU-13) energy and fossil fuel consumption and its share in EU's total consumption. This part also provides an overview of the energy intensity of EU-13 which is a measure of the energy efficiency of a country's economy; it means the amount of energy which is needed to produce a unit of GDP[1]. Similarly, in terms of industry, energy intensity of the industry is defined as the energy required to produce a material from its raw form, per unit material produced. Although the definitions vary, some industries which have higher energy consumption per unit of output are called as dirty or polluted industries and almost the same industries tend to show up on various lists. These industries are: Iron and Steel, Non-Ferrous Metals, Industrial Chemicals, Pulp and Paper and Non-Metallic Mineral Products In the second part of the study we are looking at these dirty industries' situation of EU-15 and EU-13 separately and calculate RCA figures of these industries for just EU-13. The last part analyses the relevance of calculated RCA figures and energy efficiency in dirty industries of the group of EU-13 countries.

OVERVIEW OF THE EU AND EU-13 ENERGY CONSUMPTION

EU is one of the most responsive regions on global warming and sustainable energy. Despite the share of fossil fuels (coal, lignite, oil and natural gas) in gross inland consumption of the EU28 declined from 83.0% in 1990 to 73.8% in 2013, the dependence ratio is still very high. This heavy dependency based on the imported fuels; 53.2% of total gross inland energy consumption of all energy products was from imported fossil fuels. Net import accounted for 58%, 28% and 14% of gross inland consumptions of oil, gas and solid fuels.[2] Among members, the least dependent Member States are Estonia (11.9%), Denmark (12.3%), Romania (18.6%), Poland (25.8%), the Netherlands (26.0%) and the Czech Republic (27.9%). The highest dependency rates belong to Malta (104.0%), Luxembourg (96.9%), Cyprus (96.4%) and Ireland (89.1%)[3] (Table 1).

[1]That is, energy use divided by value added.

[2]Overview of the European Energy System, http://www.eea.europa.eu/data-and-maps/indicators/overview-of-the-european-energy-system-3/assessment, 13 January 2016.

[3]Eurostat Newsrelease (2015, 9 February).

Table 1 Energy dependency of EU-28, % (2013)

BELG	*DENM*	*GERM*	*IRE*	GRE	SPA	FRA	ITA	LUX	NETH	AUS	PORT	FIN	SWE
77.5	12.3	62.7	89.0	62.1	70.5	47.9	76.9	96.9	26.0	62.3	73.5	48.7	31.6
UK	*BUL*	*CZ*	*EE*	*CROAT*	*CYP*	*LATV*	*LIT*	*HUN*	*MAL*	*POL*	*ROM*	*SLOVN*	*SLOVK*
46.4	37.8	27.9	11.9	52.3	96.4	55.9	78.3	52.3	104.1	25.8	18.6	47.0	59.6

Source: http://ec.europa.eu/eurostat/documents/2995521/6614030/8-09022015-AP-EN.pdf/4f054a0a-7e59-439f-b184-1c1d05ea2f96, (10 January 2016).

Since they are more dependent on fossil fuels, the EU has adopted targets for increasing the use of renewable energy sources and decreasing the consumption of fossil fuels. According to Eurostat data, the consumption of solid fuels and petroleum products has decreased and its share in total consumption fell from 65.1% in 1990 to 50.6% in 2013.[4] During the same period, the share of renewable in gross inland consumption increased from 4.3% in 1990 to 11.8 % in 2013; actually it is a far away from its target. On the one hand, the EU tries to reduce fossil fuel consumption while also reducing the energy intensity and trying to make more efficient and clean production. During the 2000s, an overall energy efficiency gain in EU-28 has increased from 1.1% in 2001 to 24% in 2012. In particularly, the energy efficiency gain in manufacturing industry has increased from 1.8% in 2001 to 16.9% in 2012. Among EU-28 members, new member countries such as Bulgaria, Poland and Estonia are at the top of the list on energy efficiency (Table 2).

As a result of these efforts, first the EU has been moved significantly towards previous '20-20 targets'. EU's 2020 climate package sets three crucial targets in terms of energy consumption which are; 20% cut in GHGs emissions (from 1990 levels), 20% of EU energy from renewable sources and 20% improvement in energy efficiency.[5] At the same time, following this future plan in Horizon 2020, the European Commission tries to re-design market-oriented pre-competitive R&D and innovation in advanced manufacturing activities via the Private-Public Partnership mechanism. To strengthen this plan, EU has approved the Energy Efficiency Directive on 25 October 2012. The new directive covers all end-use sectors except transport and it puts new targets on energy consumption. In 2014, the EU has agreed to review its policy framework on energy and climate policy by 2030 and the EU targets have radically changed; 40% cut in GHGs emissions, the share of renewable energy in final energy consumption increased to 27% and improving energy efficiency to 30%. Actually whole these activities are part of the Energy Union Strategy project which is coordinated by European Commission to provide secure, sustainable, competitive and affordable energy. Besides the targets on GHGs emissions from all primary energy sources, there are some other proposals which include a cut of up to 95% in carbon emissions, a minimum target of 10% for the use of bio fuels, improving energy relations with the EU's neighbours (especially with Russia) and developing technologies in renewable energy areas. In that sense, the EU cut greenhouse gas emissions by 18% in between 1990 and 2012 and increased the share of renewable in the EU energy consumption from 8.5% in 2005 to 14.1% in 2012 but it decreased to 11.8% in 2013 (Table 3).

[4]Eurostat (2015

[5]European Commission (2016).

Table 2 Energy efficiency gains in manufacturing industry of EU, %

BELG	*DENM*	*GERM*	*IRE*	GRE	SPA	FRA	ITA	LUX	NETH	AUS	PORT	FIN	SWE
39	19.3	11.6	28.1	19.1	12.3	10.7	12.3	33.4	27.5	9.2	18.4	15.8	16.1
UK	*BUL*	*CZ*	*EE*	*CROAT*	*CYP*	*LATV*	*LIT*	*HUN*	*MAL*	*POL*	*ROM*	*SLOVN*	*SLOVK*
20.6	51.7	17.4	47.1	20.4	37.3	43.3	43	38.6	18.2	49.3	16.4	19.4	40.3

Source: ODYSSEE-MURE Energy Efficiency Trends and Policies in Industry, http://www.odyssee-mure.eu/publications/efficiency-by-sector/industry/.

Table 3 Share of renewable in gross inland energy consumption % (2013)

BELG	*DENM*	*GERM*	*IRE*	GRE	SPA	FRA	ITA	LUX	NETH	AUS	PORT	FIN	SWE
6.2	24.2	10.3	6.2	10.7	14.7	9.0	16.5	3.6	4.2	29.6	23.5	29.2	34.8
UK	*BUL*	*CZ*	*EE*	*CROAT*	*CYP*	*LATV*	*LIT*	*HUN*	*MAL*	*POL*	*ROM*	*SLOVN*	*SLOVK*
5.0	10.8	8.5	12.7	16.2	6.1	36.1	18.1	8.3	1.5	8.7	17.2	16.5	8.2

Source: http://ec.europa.eu/eurostat/statisticsexplained/images/8/83/Share_of_renewables_in_gross_inland_energy_consumption%2C_2013_%28%25%29_YB15.png, 10 January 2016.

In the context of transition to a more competitive but sustainable path, the EU countries need to decrease their energy intensities (i.e. increase the energy efficiencies). When we look at figures in Table 4, energy intensities in the USA and China are higher than EU-27 and Japan. In other words, China, as the world's largest energy consumer country, is the least energy efficient country among these countries.

Table 4 Energy intensities (TJ per million $ of value added in PPPs 2005), 1995, 2009

	Total Economy		*Manufacturing**	
	1995	*2009*	*1995*	*2009*
EU-27	10.5	7.8	12.2	9.1
- EU-15	9.8	7.6	11.0	9.4
- EU-12	15.8	9.7	23.4	7.8
China	20.4	13.6	26.4	13.3
Japan	9.5	8.3	11.2	9.9
USA	13.1	9.0	16.4	11.1

*Not included NACE rev 1-23: coke, refined petroleum and nuclear fuel.
Source: WIOD (2013); WIIW calculations from 2014-Energy cost and EU Industrial competitiveness.

On the other hand, the cost of energy in the output is another crucial variable for strengthening competitiveness of any country. The data show that EU and US are becoming close in terms of energy cost share in gross output; but China is the highest level as expected. In terms of total economy both countries' figures are 4.6% in 2011 and around 3% for manufacturing (Tables 5 and 6). However, from the Table 5 we can see that energy intensive industries such as chemicals, basic and fabricated metals and non-metallic minerals industries in the US and EU have lowest cost shares as others have been driven by higher costs.

Table 5 Energy cost share in basic prices (in % of gross output)

	Total Economy				*Manufacturing**			
	1995	*2000*	*2007*	*2011*	*1995*	*2000*	*2007*	*2011*
EU-27	3.0	3.2	4.1	4.6	2.3	2.2	2.8	3.0
China	5.2	5.9	7.7	7.7	4.4	4.7	5.7	5.9
Japan	2.8	3.3	4.8	5.1	2.9	3.3	4.6	5.4
USA	2.8	3.6	4.6	4.6	2.3	2.8	3.1	2.9

*Not included NACE rev 1-23: coke, refined petroleum and nuclear fuel.
Source: WIOD (2013); WIIW calculations from 2014-Energy cost and EU Industrial competitiveness.

Table 6 Energy cost shares by manufacturing industry in basic prices (in % of gross output)

	EU-27		*China*		*Japan*		*USA*	
	1995	*2011*	*1995*	*2011*	*1995*	*2011*	*1995*	*2011*
Food and beverages	1.7	2.5	1.3	1.5	1.5	2.3	1.8	2.0
Textile and products	2.2	3.1	1.2	2.2	2.2	3.3	1.7	2.2
Leather and Footwear	1.1	1.4	0.5	1.2	1.6	2.0	1.2	0.8
Wood and products	2.0	2.8	3.1	3.1	1.9	2.5	2.1	3.1
Pulp, Paper and printing	2.5	3.2	3.8	3.6	3.4	4.8	2.4	3.2
Coke, ref.petr. and Nuc fuels	47.8	62.0	56.9	72.2	20.8	47.0	62.2	67.9
Chemicals and Products	4.4	7.4	9.9	18.9	6.8	13.1	5.9	7.8
Rubber and Plastics	2.5	3.5	2.8	3.3	3.1	3.3	3.0	2.5
Other Non-Metallic mineral products	5.6	7.4	10.5	15.5	9.2	16.8	4.6	5.8
Basic and Fabricated Metals	3.7	4.1	7.7	9.8	4.4	10.2	3.3	4.2
Machinery	1.2	1.3	2.8	3.5	1.2	1.5	1.1	1.0
Electrical and Optical Equip	1.0	1.1	1.3	1.4	1.6	2.2	1.3	0.5
Transport Equip	1.2	1.1	1.8	1.6	1.2	1.6	0.7	0.8
Manufacturing, nec	1.4	2.1	1.9	1.9	2.0	3.0	1.2	0.8

Source: WIOD (2013); WIIW calculations from 2014-Energy cost and EU Industrial competitiveness.

Trend in energy intensity over time has also been down for EU; during the same period, almost all EU members show a decrease in energy intensity; the least energy intensive countries in the EU are after Ireland, Malta, Lithuania, Cyprus, Poland, Denmark and United Kingdom (UK), but the most energy intensive countries are Finland, Sweden, Bulgaria and Luxembourg. However, the largest fall is lately observed in some new members such as Poland (−10.0%), Slovakia (−8.6%), Lithuania and Romania. Only Slovenia showed a lower decline of energy intensity of −2.8% per annum. Despite these positive improvements in the figures of energy intensity in the EU, the new member countries (EU-13) still have higher values in 2013 (Table 7 and Figure 1).

On the other hand, in most of the EU-13 countries, after the dramatic decline in energy intensity it is expected that these countries RCA figures show better performances. Because it is widely accepted that competitiveness will be enhanced when industry consumes less energy. In other words, more energy intensity the low RCA figures. However the discussion on energy efficiency and industrial competitiveness is regarded with the concepts of technological capability, innovative capability and/or absorptive capacity. It means countries need such capacities if they want to increase their energy efficiency and decrease

Table 7 Energy intensity of EU-13 countries, 2002–2013 (kg of oil equivalent per 1000 euro)

	BUL	*CZ*	*EE*	CROAT	CYP	LV	LT	HUN	ML	POL	ROM	SLOVN	SLOVK
2002	962.9	471.5	558.9	261.1	200.0	410.6	528.8	330.1	174.1	409.3	572.8	267.2	575.3
2003	942.0	475.8	571.2	265.1	212.4	405.4	499.1	324.2	190.1	407.7	567.7	262.6	546.7
2004	866.2	465.7	550.8	255.0	191.2	382.2	474.6	306.6	196.1	387.1	515.9	259.2	512.7
2005	849.4	431.2	501.8	246.7	186.7	355.2	415.4	311.1	197.1	377.3	491.3	255.0	494.4
2006	823.5	413.6	444.7	235.9	186.2	332.0	377.9	297.7	180.5	373.0	471.4	241.0	452.6
2007	759.9	391.3	464.6	235.0	185.0	309.6	374.8	290.6	184.3	349.2	441.5	225.5	387.6
2008	711.7	371.1	468.7	223.5	188.0	305.9	363.2	285.9	177.0	335.9	409.9	230.6	375.7
2009	661.4	364.4	491.3	230.6	186.3	357.1	389.6	289.7	163.8	319.2	387.4	227.8	362.2
2010	668.8	374.1	546.3	230.6	178.8	357.1	389.6	294.1	166.8	327.4	394.6	231.0	369.3
2011	705.5	353.9	505.3	231.9	174.8	333.5	299.1	281.6	164.3	314.0	393.7	230.5	349.3
2012	669.9	355.7	478.4	225.6	167.5	328.6	292.1	268.7	171.3	298.0	378.9	227.5	329.3
2013	610.6	353.8	512.7	219.5	154.1	310.6	266.4	256.5	143.6	294.7	334.7	225.8	337.2
% change	−36.5	−25.0	− 8.2	−16.0	−23.0	−24.3	−49.6	−22.2	−17.5	−28.0	−41.5	−15.4	−41.3

Source: https://datamarket.com/data/set/1agh/energy-intensity-of-the economy#!ds=1agh!yjx=5.e.b.z.1.d.m.v.n.10.7.c.u.g.i.x.f.p.a.r.17.w.8.2.o.k.18.h.4.l.y.t.3&display=choropleth&map=europe&classifier=natural&numclasses=5&s=90o.

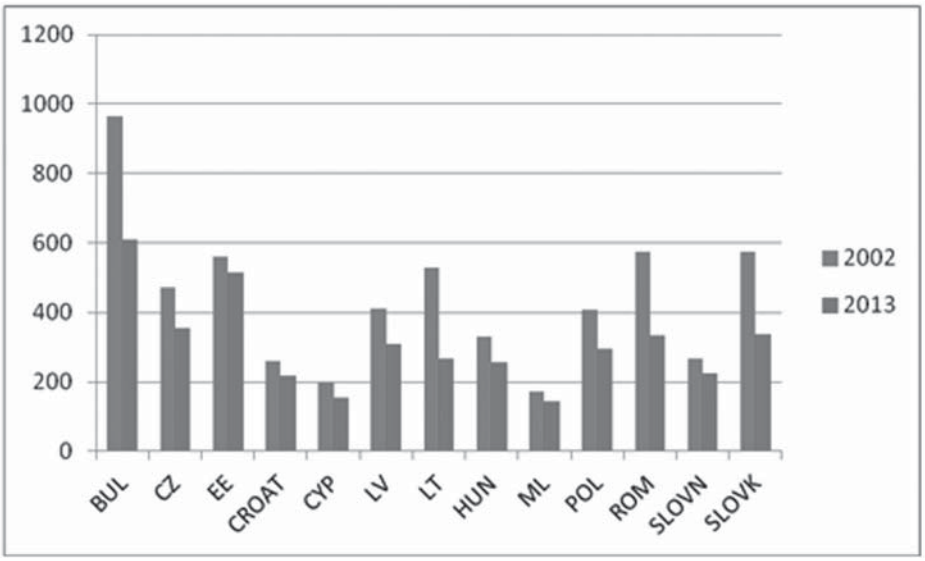

Figure 1 Dramatic decline in energy ıntensity in EU-13 countries, kgoe/000 euro

Source: Data from the above Table 7.

their energy intensities. So the energy intensity is an important but not the only factor to strengthen competition.

Next part of this study aims to calculate the RCA figures of energy-intensive industries in EU-13 countries which are on the path of energy efficiency.

Competitiveness of dirty industries in EU-13

Examining the period from 2000 to 2008, the share of the industrial sector in final energy consumption of EU-28 has been increasing but after 2008 the trend has been downward steadily. Overall period, between 2000 and 2013, the share of industry in final energy consumption has decreased from 331.9 mtoe to 276.6 mtoe. According to Eurostat, *of the major sectors, the largest fall in energy consumption between 1990 and 2013 took place in the industry sector; for example, between 2005 and 2013 energy consumption in the industry sector fell at an average rate of 20%*. Again according to the same source, *this was largely the result of a shift towards less energy-intensive manufacturing industries*.[6] Therefore, at this point it is important to ask whether these industries' comparative advantage increase or not. In other words, RCA were calculated to analyse whether or not the EU-13 countries' specialise on energy-intensive products.

In the reminder of this part, empirical results for calculating the RCA of six energy-intensive industries are presented (Table 8). These six industries cover around 2/3 of total consumption.

[6]EEA (2015).

Table 8 RCA figures of selected most dirty industries in EU-13 countries, 2000 and 2013

2000	*BUL*	*CZ*	*EE*	CROAT	CYP	LV	LT	HUN	ML	POL	ROM	SLOVN	SLOVK
5	**1.08**	0.76	0.60	**1.34**	0.00	0.68	**1.02**	0.65	0.17	0.70	0.62	**1.17**	0.85
64	0.41	**1.07**	**1.03**	**1.18**	0.49	0.61	0.53	0.72	0.02	**1.72**	0.34	**2.78**	**2.37**
66	0.86	**2.28**	0.68	**1.99**	**1.00**	0.47	0.77	0.62	0.09	**1.11**	0.90	**1.23**	**1.27**
67	**34.0**	**1.87**	0.45	0.46	0.04	**2.73**	0.47	0.52	0.005	**1.48**	**3.45**	**1.37**	**4.11**
68	**5.50**	0.60	**1.39**	**1.11**	0.92	**1.45**	0.15	0.92	0.10	**2.16**	**2.04**	**2.10**	**1.40**
69	0.77	**3.20**	**1.63**	**1.18**	0.30	0.53	0.62	**1.06**	0.35	**2.48**	0.77	**2.25**	**1.50**
2013													
5	0.27	0.55	0.61	0.99	0.00	0.59	**1.09**	0.95	**1.16**	0.82	0.49	**1.40**	0.41
64	0.80	0.17	**1.17**	**1.34**	0.21	0.85	**1.10**	**1.23**	0.09	**2.46**	0.48	**1.95**	**1.37**
66	**1.00**	**1.00**	0.92	**2.08**	**1.57**	0.85	0.64	0.80	0.11	**1.05**	0.25	0.80	0.74
67	0.98	**1.33**	0.55	0.42	0.20	**1.46**	0.34	0.51	0.05	0.97	**1.46**	**1.10**	**2.20**
68	6.41	0.66	0.32	**1.00**	0.84	0.58	0.10	0.46	0.01	**1.75**	0.78	**1.26**	**1.08**
69	0.84	**2.51**	**1.63**	**1.82**	0.12	**1.22**	**1.21**	**1.05**	0.22	**2.24**	**1.22**	**1.90**	**1.63**

Note: The numbers on the left column represent the SITC classification. SITC 5: Chemicals and related products; SITC 64: Paper, paperboard and articles of paper pulp, of paper or of paperboard; SITC 66: Non-metallic mineral manufactures; SITC 67: Iron and Steel; SITC 68: Non-ferrous metals; SITC 69: Manufactures of metals.
Source: Our own calculation.

In the case of six energy-intensive industries, almost all new members' RCA figures are decreasing, that is, losing their competitiveness. So when these countries' dirty industries become 'clean' (in other words increase their energy efficiency or decrease their energy-intensity) then they are losing their comparative advantage performances. Particularly two largest energy consuming industries (Chemicals and Iron and Steel) RCA figures decline in almost all members.

In Bulgaria the manufacturing sector accounted for 22.3% of the gross value added however among manufacturing industries the share of chemicals and pharmaceuticals has decreased from 22.0 % in 2008 to less than 15.7 % in 2011. This information is supported by the RCA figures of Bulgarian chemicals sector which is decreased from 1.08 in 2000 to 0.27 in 2013. Bulgaria is the most energy-intensive country in the EU with low energy and resource efficiency (see Table 7). The manufacturing sector in the Czech Republic is very important and the share of the industry is 27.0% of value added in 2014. The energy intensity of the Czech Republic has been declining over recent years but still remains high when compared to other EU countries.

In Estonia the share of manufacturing in value added is 16% and high value added sectors are increasing their share in this country. Estonia has specialised in capital-intensive industries; particularly wood products such as paper, paperboard and articles of paper pulp, of paper or of paperboard (SITC 64) have increased its RCA figures from 1.03 in 2000 to 1.17 in 2013. This specialisation in such energy-intensive industries is verified by energy intensity figures of Estonia; between 2000 and 2013, the energy intensity of the country has decreased by 16%.

In Croatia the share of manufacturing sector in value added is 15%. In 2000, except iron and steel, all energy-intensive industries have higher RCA figures. Despite the country's efforts to use more renewable energy in total energy consumption, these energy intensive industries have still high RCA in 2013.

The main problem of Cyprus is the highest electricity prices which reduce the competitiveness of industries in the country. During 2000s, only the non-metallic mineral manufactures has comparative advantage, the other energy-intensive industries have no advantage.

The manufacturing sector's contribution to the Latvian economy decreased from 14% in 2013 to 12% in 2014. Among the top ten export products of the country are wood, metals, chemicals and machinery. In 2000, iron and steel and non-ferrous metals (SITC 67 and 68) are the only two industries have comparative advantage; in 2013 non-ferrous metals lost its RCA while the metals products have increased competitiveness.

Manufacturing industry in Lithuania has 19% in share in value added. Lithuania has a strong RCA in wood and wood products, paper, refined petroleum, chemicals, rubber and plastics.

From Table 7 it is observed that the most dramatic decline in the energy intensity occurred in Lithuania. However this change has not reflected on the RCA figures of the country's energy-intensive industries. Thus from 2000 to 2013, the RCA figures of three energy-intensive industries (SITC 5, SITC 64 and SITC 69) have increased.

The share of manufacturing industry in the total value added of Hungary is 24% in 2014 which shows a strong performance among EU-13 members. In 2013, paper, paperboard and articles of paper pulp, of paper or of paperboard industry and metals products industry have strong RCA while in 2000, manufactures of metals is the only industry among these dirty industries. Malta is not so strong in manufacturing industry however the country has obtain RCA in chemical industry particularly pharmaceuticals (Table 8).

Poland's share of manufacturing in total value added is 18% in 2014 and it is above the EU's average. However the performance of the country's energy efficiency is so weak. Despite the decrease in energy-intensity, all energy-intensive sectors have competitiveness in whole economy. On the other hand Romania has good performance in manufacturing industry; The country's energy intensive figures has decreased dramatically from 2000, in 2013 in terms of energy intensity, Romania is the fourth biggest country among the other EU-13 countries. Among these dirty industries, non-ferrous metals lost its competitiveness but manufacture of metals gained RCA in 2013. On the other hand Slovenia has strong RCA in most energy-intensive industries and the energy intensity of the country has decreased by 15% during 2000−2013; however the country still shows a high level of energy intensity. Finally the industry of Slovakia is one of the most competitive industries among EU-13. The energy intensity of the country has dramatically decreased during the period; as a result of this change Slovakia has lost RCA in some energy-intensive industries such as chemical and non-metallic mineral manufactures. Despite the fall in energy intensity, Slovakia is one of the most energy-intensive member countries.

CONCLUSION

The policy shift in accordance with EU's 20-20-20 targets have forced to change the behavioural patterns of the industries in Europe and to find new ways to compete for the firms in the realm of their own industries. The 20-20-20 targets-based change in the industries could be branded with the motto 'Exit from Europe' and it is inevitable that these industries will be eventually looking for new locations other than Europe. In this study, our findings suggest that the comparative advantages of some energy intensive industries such as chemicals and non-metallic mineral manufactures, iron and steel and non-ferrous metals have been getting weaker for EU's last member countries during the period of interest. However the process is just up the road.

REFERENCES

Abimanyu, A. (1996) 'Impact of free trade on industrial pollution: Do Pollution Havens Exist?' *ASEAN Economic Bulletin*, Vol. 13, No. 1, Available at: http://www.jstor.org/stable/25770625?seq=1#page_scan_tab_contents.

Broner, F., Bustos, P. and Carvalho, V.M. (2012) 'Sources of comparative advantage in polluting ındustries', *NBER Working Paper* No. 18337, Available at: http://www.nber.org/papers/w18337, Accessed on 28 December 2015.

Cole, M.A., Elliott, R.J.R. and Shimamoto, K. (2005) 'Why the grass is not always greener: the competing effects of environmental regulations and factor intensities on US specialisation', *Ecological Economics*, Vol. 54, No. 1, pp.95–109.

EEA (2015) *Final Energy Consumption by Sector and Fuel*, Available at: http://www.eea.europa.eu/data-and-maps/indicators/final-energy-consumption-by-sector-9/assessment.

European Commission (2014) *Reindustrialising Europe. Member States' Competitiveness Report 2014*, EU Commission Staff Working document, Available at: http://www.ec.europa.eu/DocsRoom/documents/6748/.

European Commission (2016) *2020 Climate and Energy Package*, Available at: http://ec.europa.eu/clima/policies/strategies/2020/index_en.htm.

Eurostat (2015) *Consumption of Energy*, Available at: http://ec.europa.eu/eurostat/statistics-explained/index.php/Consumption_of_energy.

Eurostat Newsrelease (2015, 9 February) *Energy Production and Consumption in 2013*, Available at:http://ec.europa.eu/eurostat/documents/2995521/6614030/8-09022015-AP-EN.pdf/4f054a0a-7e59-439f-b184-1c1d05ea2f96.

Lehr, C.S. and Maxwell, J.W. (2000) 'Comparative advantage, trade and transboundary pollution', *Open Economies Review*, Vol. 11, pp205–227, Available at: http://link.springer.com/article/10.1023%2FA%3A1008370706461#page-2, Accessed on 28 December 2015.

Low, P. and Yeats, A. (1992) 'Do 'Dirty' Industries Migrate?' in P. Low (Ed.). *International Trade and the Environment*, Washington, DC: World Bank.

Tobey, J.A. (1990) 'The effects of domestic environmental policies on patterns of world trade: an emprical test', *Kyklos*, Vol. 43, No. 2, pp.191–209.

WIOD (2013) 'WIOD Data', 13 November Release, Available at: http://www.wiod.org/new_site/data.htm.

WIOD (2014) 'Chapter 6: energy costs and EU industrial competitivenes in helping firms grow: European competitiveness report 2014', EC Commission Staff Working Document SWD (2014)277 final.

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