International trade in environmental goods – case study in Poland

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Abstract
The environmental goods sector (EGS) has a positive environmental impact by reducing and minimizing pollutions, wastes, hazardous substances and the use of natural resources as well as promoting environmental-friendly technologies. The trade in the EGS is a part of the transformation to the sustainable economic and environmental policies, e.g. circular economy, clean technology. The topic of green trade is widely discussed in the international forum because of the negotiation on the liberalization in trade EGS, which can lead to reduce tariff barriers and customs duty. However, there are many issues which are related to this topic such as environmental products, which can be used for non-environmental goals and lack of standard classification in EGS. Nowadays there are few lists of environmental products and service, therefore, the development of the EGS strategy is a difficult challenge for today’s global economies. The exchange of these products and services counts still a small share in the turnover, but it shows a growing tendency. The analysis was conducted based on the 54 products introduced by APEC in 2012. The aim of the paper is to demonstrate the tendencies in trade in EGS between Poland and other EU countries, especially in the context of environmental policies which have been introduced for the last several years. In the paper, there is also devised a demand trend for environmental products. The good practices developed may be a recommendation for the development of the EGS sector in Poland.

Keywords: environmental goods, international trade, manufacturing sectors

1. Introduction
Environmental goods sector (EGS) is one of the key elements involved in the development of pro-environmental strategies, e.g. Agenda for Sustainable Development (Arun et al. 2017; Araya 2016) and decoupling (Bucher H. et al., 2014.). Demand for environmental products as well as “green” services are expected to continue to increase, the market reached “USD 866 billion in 2011, and is expected to rise to USD1.9 trillion by 2020” (Bucher H. et al., 2014). On the other hand, there is a need to strengthen trade of these products and services; by means of promoting environmental-friendly solutions. This could be accomplished through the use of renewable energy, waste management and recycling, air control pollution as well as reducing adverse environmental impact and climate change mitigation.

The most important aspects of the trade in this sector are the environmental lists of products or services. Nowadays many organizations have developed these lists among others United Nations Conference on Trade and Development, Asia-Pacific Economic Co-operation (APEC), European Commission, Organization for Economic Co-operation and Development (OECD)/Eurostat (Sugathan, 2016). The issues of defining environmental sector are as follows: the number of environmental products and/or service and the idea of demand hierarchy for these products and service, i.e., in 1996 OECD/Eurostat presented a document which covers a wide range of products and services related to pro-environmental industry (OECD/GD(96)117). This document divides environmental sector into three groups such as Group A - Pollution Management, Group B - Clean technologies and Products, Group C - Resource Management Technologies. Also, in 2012 during the 20th meeting in
Vladivostok in Russia APEC founded the first agreement to liberalize the trade. There, members of APEC introduced 54 environmental products based on Harmonized Commodity Description and Coding Systems (HS). According to this agreement “reduce applied tariff rates to 5 percent or less by the end of 2015” (20th APEC Economics Leaders’ Declaration, Vladivostok, Russia. Annex C: APEC List of Environmental Goods). When defining environmental goods, it is also very important to take into account, probabilities of multi-purpose uses of these products i.e. some of the green products can be used not only for the environmental purpose for example: 847989 “Machines And Mechanical Appliances Having Individual Functions, Not Specified Or Included Elsewhere In Chapter 84”, 903289 „Automatic regulation and control instruments and apparatus (excluding thermostats, manostats, and hydraulic types) (Vossenaar, 2013).

In 2014, negotiations were started on the implementation of Environmental Goods Agreement between 17 members of World Trade Organization (WTO). The topic of the discussion liberalization of the trade in green goods based on a list of EGS introduced by APEC in 2012 (European Commission, Final Report Trade Sustainability Impact Assessment on the Environmental Goods Agreement). Over the past years, EU-28 has been one of the leaders in trade in environmental products, which is why the participation of the European Union is so important during negotiations (Vossenaar, 2013; Ambroziaka 2015). According to Eurostat, trade in 54 products classified by APEC, in 2013 in EU was 71 billion EUR of export and 34 billion EUR of import. In the context of the development of environmental policy as well as socio-economic aspects, the article presents trends in internal market and trade in environmental products between Poland and EU-28 and identifies the key regulations for the development of Polish import and export of environmental goods.

2. The tendency of trade in environmental goods between Poland and EU-28

The analysis of environmental products was conducted on the basis of the classification introduced by APEC in 2012 (Annex C—APEC List of Environmental Goods to the 2012 APEC Leaders’ Declaration, released on September 9, 2012, in Vladivostok, Russia.). According to applicable rules (Council of Ministers’ decree, 2015) goods have been put in Section C of Polish Classification of Activity (MANUFACTURING)2:

- Division: 28 - Manufacture of machinery and equipment n.e.c. – 23 products;
- Division 27 Manufacture of electrical equipment - 6 products;
- Division 26 - Manufacture of computer, electronic and optical products statistics – 20 products;
- Division 25 Manufacture of fabricated metal products, except machinery and equipment – 4 products.

Most of the products in the divisions supports activities such as: waste management and recycling (waste incinerator, wastewater management, water/wastewater filtration technologies, water treatment plants, solid waste treatment, preparing organic waste for composting, waste separator machines), renewable energy (solar thermal energy, PV cells, wind turbines, production of biomass flue, convert DC). Consequently, air control is implemented as a contemporary strategy for environmental protection, for example a circular economy and principles of minimizing the negative impact on the environment, e.g. clean production rules.

The value of export of the products from Poland to EU-28 in 2010-2016 increased by 69% (Tab.1) and import by 66% (Tab. 2). Over the past years, Division 28 has had the most significant share in the export of environmental products. The decreasing share in global export from Poland to other EU countries was recorded for the Division 25. Goods are mainly exported to (Germany, France). Taking into account the percentage share of a given country in 2010-2016 in particular sectors, the largest recipients of this group of products were:

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1 European Union, Australia, Canada, China, Chinese Taipei, Costa Rica, Hong Kong (China), Japan, New Zealand, Norway, Singapore, South Korea, Switzerland, and the US. Israel, Turkey, Iceland (joined in 2015).
2 The analysis does not include products such as: 441872 (HS 2007): Other Assembled Flooring Panels, Multilayer, of Bamboo (44187210)
• Division 25 (Germany 39%, United Kingdom 13%)
• Division 26 (Germany 49%, United Kingdom 7%)
• Division 27 (Germany 53%, France 8%)
• Division 28 (Germany 44%, Denmark 8%, United Kingdom 7%)

Table 1. The value of export of environmental goods in the various divisions of Polish Classification of Activity from 2010 to 2016 (current price, millions EUR).

<table>
<thead>
<tr>
<th>Year</th>
<th>Division 25</th>
<th>Division 26</th>
<th>Division 27</th>
<th>Division 28</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>121</td>
<td>391</td>
<td>362</td>
<td>472</td>
<td>1347</td>
</tr>
<tr>
<td>2011</td>
<td>140</td>
<td>328</td>
<td>359</td>
<td>451</td>
<td>1279</td>
</tr>
<tr>
<td>2012</td>
<td>106</td>
<td>295</td>
<td>368</td>
<td>543</td>
<td>1313</td>
</tr>
<tr>
<td>2013</td>
<td>59</td>
<td>341</td>
<td>360</td>
<td>541</td>
<td>1302</td>
</tr>
<tr>
<td>2014</td>
<td>49</td>
<td>805</td>
<td>360</td>
<td>546</td>
<td>1760</td>
</tr>
<tr>
<td>2015</td>
<td>43</td>
<td>909</td>
<td>309</td>
<td>772</td>
<td>2034</td>
</tr>
<tr>
<td>2016</td>
<td>49</td>
<td>645</td>
<td>327</td>
<td>916</td>
<td>1937</td>
</tr>
</tbody>
</table>

Source: Own study based on data from Central Statistical Office.

In contrast to export, import from the EU-28 to Poland saw an increase in each division over 2010-2016 (tab.2). Division 28 marked the largest share in import; the marginal share of the total import was held by the 25th Department. The main countries from which Poland imports environmental products are (Germany and Italy). Taking into account the percentage share of a given country in 2010-2016 in particular sectors, the most substantial recipients of this group of products were:

• Division 25 (Germany 53%, Finland 17%, Czech Republic 8%)
• Division 26 (Germany 49%, Italy 12%, Spain 9%)
• Division 27 (Germany 43%, Italy 9%, France 7%)
• Division 28 (Germany 50%, Denmark 11%, Spain 9%)

Table 2. The value of import of environmental goods in the various divisions of Polish Classification of Activity from 2010 to 2016 (current price, millions EUR).

<table>
<thead>
<tr>
<th>Year</th>
<th>Division 25</th>
<th>Division 26</th>
<th>Division 27</th>
<th>Division 28</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>32</td>
<td>544</td>
<td>194</td>
<td>884</td>
<td>1653</td>
</tr>
<tr>
<td>2011</td>
<td>55</td>
<td>547</td>
<td>243</td>
<td>934</td>
<td>1778</td>
</tr>
<tr>
<td>2012</td>
<td>31</td>
<td>516</td>
<td>263</td>
<td>1088</td>
<td>1898</td>
</tr>
<tr>
<td>2013</td>
<td>25</td>
<td>569</td>
<td>244</td>
<td>1112</td>
<td>1950</td>
</tr>
<tr>
<td>2014</td>
<td>60</td>
<td>689</td>
<td>310</td>
<td>1452</td>
<td>2511</td>
</tr>
<tr>
<td>2015</td>
<td>61</td>
<td>752</td>
<td>326</td>
<td>1814</td>
<td>2953</td>
</tr>
<tr>
<td>2016</td>
<td>73</td>
<td>725</td>
<td>326</td>
<td>1382</td>
<td>2505</td>
</tr>
</tbody>
</table>

Source: Own study based on data from Central Statistical Office.

Export from Poland into EU:
1. 840410 - Auxiliary plant for use with boilers of heading 84.02 or 84.03 (for example, economisers, super-heaters, soot removers, gas recovers); condensers for steam or other vapour power units. (Division 25)
2. 841290 - Other engines and motors – Parts (Division 28)
3. 841780 - Other industrial or laboratory furnaces and ovens, including incinerators, non-electric (Division 28)
4. 841939 - Dryers, other (Division 28)
5. 841960 - Machinery for liquefying air or other gases (Division 28)
6. 842121 - Filtering or purifying machinery and apparatus for liquids: for filtering or purifying water. (Division 28)
7. 842129 - Filtering or purifying machinery and apparatus for liquids: other (Division 28)
8. 842139 - Filtering or purifying machinery and apparatus for gas (other than intake air filters for internal combustion engines) (Division 28)
9. 850231 - Other electric generating sets: Wind-powered (Division 28)
10. 850239 - Electric generating sets and rotary convertors: other (Division 27)
11. 851410 - Resistance heated furnaces and ovens (Division 28)
12. 851420 - Furnaces and ovens; functioning by induction or dielectric loss (Division 28)
13. 851490 - Parts of industrial or laboratory electric furnaces and ovens; other laboratory induction or dielectric heating equipment (Division 28)
14. 902680 - Other instruments and apparatus (Division 25)
15. 902710 - Gas or smoke analysis apparatus (Division 25)
16. 903149 - Other measuring and checking instruments, appliances and machines, not specified or included elsewhere in this chapter: Other optical instruments, appliances and machines elsewhere specified for measuring or checking (Division 26)

Import from EU into Poland:
1. 840490 - Parts for auxiliary plant for boilers, condensers for steam, vapour power unit (Division 25)
2. 841199 - Parts of gas turbines (Division 28)
3. 841919 - Instantaneous or storage water heaters, non-electric (other than instantaneous gas water heaters) (Division 27)
4. 842139 - Filtering or purifying machinery and apparatus for gas (other than intake air filters for internal combustion engines) (Division 28)
5. 854140 - Photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light emitting diodes (Division 26)
6. 854390 - Parts of the machines and apparatus of 85.43 (Division 27)
7. 902610 - Instruments for measuring or checking the flow, level, pressure or other variables of liquids or gases (Division 26)
8. 903149 - Other measuring and checking instruments, appliances and machines, not specified or included elsewhere in this chapter: Other optical instruments, appliances and machines elsewhere specified for measuring or checking (Division 26).

In 2010-2016, the balance of trade in environmental products was negative. Despite high export dynamics in department 28, in 2010-2016, imports exceeded exports. In 2016, the balance was EUR -568 million, of which 83% had Division 28, which is both the largest importer and exporter. The second sector in terms of exports was Division 26, which had only in the years 2014-2015 had a positive balance. Therefore, based on analysis of the tendencies in trade exchange of particular environmental products, it has been concluded that the most prospective of these products in the Divisions (more than double increase in the analyzed period) are:
Due to the greater volatility in the structure of exports from Poland to the EU-28, a definite increase was noted in 12 sections out of 58, and imports in 8. Nevertheless, the sectors mentioned above are considered prospective in the trade between Poland and EU-28.

On the basis of the data obtained from the Central Statistical Office, the values corresponding to production, import, and export for the years 2010 - 2016 were determined for individual environmental goods classified to the PKD Divisions: 25, 26, 27, 28 (aggregated values shown in Figure 1). Some of the data were obtained in PLN and another part in EUR. Then these data were converted according to the annual average exchange rate of euro. Individual values in categories are characterized by the year-on-year volatility of up to 70%.

Figure 1. The value of marketed production, import and export between Poland and Eu-28 related to environmental products [millions EUR]

Source: Own study based on data from Central Statistical Office.

Production amount represented in Euros, increases on average by 9.5%. It is also noticeable that exports from Poland to the EU are larger (2010: 67% of all export, 2016: 63%) than imports from the EU to Poland (2010: 44% of all import, 2016: 59%). Nevertheless, Polish imports are more than exports (by 85% in 2010 and 40% in 2016); one of the reasons is the capital-intensive production of environmental goods and higher technological requirements in relation to other industries has become

The observed increase in demand took place mainly in divisions 27 and 28. The most significant increase in demand was observed in department 25 – nearly tripled; this division increased its share in the group of environmental goods from 1.9% to over 4%. The goods included in this division were characterized by the most volatile demand because between 2013 and 2016 they increased more than five times. The demand for goods included in chapter 28, which constitutes the largest share in the group (43.1% in 2010 and 42.8% in 2016), increased by 37%, or one percentage point less than the demand for goods in the whole group of environmental goods. The second group in terms of share is division 26 (34.6% in 2010 and 30% in 2016). The demand for goods in this group from 2012 to 2015 was lower by several dozen percents than in 2010, but already in 2016 it was higher by 19%. Among the analysed four divisions, the most steady upward trend was observed for division 27.

The share of imports from the EU to Poland increased for division 28 from 27.2% to 31.09%, and in terms of money more than twofold increased for goods from section 25. In all groups, there was an increase by at least 50%. For all departments, the share of imports in the total demand for environmental goods increased from 22% to over 24%.
The more volatile structure was for exports than for imports, exports from Poland to EU fell in section 25 (by 60%) and in department 27 (by 10%). Exports from Poland to the EU increased by over 90% for section 28 and for department 26 by over 60%.

3. Demand trend of environmental products in Poland

For the variables of the trend, the apparent demand for goods (DEG) was calculated without taking into account the volume of goods storage:

\[ \text{DEG (year)} = \text{production(year)} + \text{import(year)} - \text{export (year)} \]

The demand expressed in monetary terms for environmental goods in relation to this size from 2010 (iDEG) expresses the following equation:

\[ \text{iDEG (year)} = \frac{\text{DEG(year)}}{\text{DEG(2010year-1)}} \]

\[ \text{ip(year)} = \frac{\text{EUR/PLN(year)}}{\text{EUR/PLN(2010year-1)}} \]

where:

EUR/PLN – average yearly exchange rate EUR/PLN

The exchange GDP related to value from 2010 in the previous year (ig):

\[ \text{ig(year)} = \frac{\text{GDP (year)}}{\text{GDP (2010year-1)}} \]

GDP – Gross Domestic Product in Poland

Taking into account the multiple regression analysis for the data: year, ip, ig, the following dependence on the computational value of iDEG iDEG' was determined (R² = 0.997).

\[ \text{iDEG' (year)} = -0.0002300197\times\text{year} - 0.582191.7085\times\text{ip(year)} + 2,0230846.52917\times\text{ig(year)} \]

The next stage of the analysis was using the data published by the Ministry of Finance and Development regarding the forecast of the macroeconomic GDP growth of the Polish economy (ig') (Ministry of Finance and Development, 2017). Including the euro (ip'), a 4-year forecast was calculated based on the trend determined in equation 4.
Due to the assumed drop in the value of the Euro in relation to the Polish currency and the expected increase in the demand for environmental goods, this market in Poland should expand within the marketplace. An increase in demand is expected for all groups of environmental goods, but the largest increase is estimated for divisions 25 and 27.

Given the low level of technological development of Poland in comparison to EU countries with an increase in the demand for environmental goods, a higher increase in imports of goods to Poland is expected than in exports from Poland. The share of imports from EU countries to Poland was not exceeded 32% in total demand for particular groups of goods.

4. Conclusions

The analysis of trade between Poland and the EU-28 in 2010-2016 was obtained for the demand for environmental goods, in particular, the Polish Classification of Activity divisions is characterized by high volatility. These groups of products are both crucial for the development of the Polish economy and for maintaining the trend related to environmental protection for Poland and EU countries, especially for the implementation of new strategies such as the circular economy. Considering export and import between Poland and EU-28, Germany had an unusually large percentage share. There were more significant counts of Polish exports to the EU was also observed in the value of the entire export of green products in comparison to the value of imports.

The implementation of sustainable policy at the regional and national level is influenced by the increase in the share of environmental products in total trade. Strategies and ideas for environmental protection are included in the priority axes of Poland's development. For this reason, many documents are also implemented, such as State Raw Materials Policy (PSP) (2018) and Roadmap of transition towards a circular economy (2018). Among the goals of these documents, one can stand out the natural environment protection as well as the improvement of the life quality and the social health. One of the ways to achieve these goals is the increase mentioned above the share of environmental products in trade.
On the other hand, by the exchange of green products and department related to, for instance, waste management or renewable energy sources, can be improved. These departments are considered as crucial sectors in environmental protection. It is worth noting that the increase of the value trade, as well as the increase in demand, is also affected by non-measurable factors such as, for example, social awareness and legal regulations of environmental protection. The dependence of the trend set for the demand for environmental products on changes both GDP for Poland and the euro exchange rate (EUR/PLN) calculated by year on year was also shown in this paper.

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