DOMINANT PV TRADE FLOWS IN EUROPE

A customs data analysis performed by the The European Solar Manufacturing Council (ESMC)

The European Solar Manufacturing Council (ESMC) is the organisation representing the interests of the European PV manufacturing industry. The Council relies on key industrial companies, organisations and research centers active in the PV sector rooted in Europe. ESMC aims at promoting and supporting the PV manufacturing industry and its value chain at the European level, speaking with one voice.

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BRIEF BACKGROUND AND AIM

During the first years of the global PV market development, Europe held a majority share. With time, other parts of the world, with China in the lead, started to gain larger market shares in terms of both installation and manufacturing volumes. At the end of 2019 the European Union was the second largest market in terms of cumulative capacity after China, with three individual markets in the top 10, namely Spain, Germany and Ukraine in place 7, 8 and 9.

With the mission of ESMC in mind, the following study has been conducted. To obtain an overview of the central trade flows in and out of Europe, customs data has been analysed. By mapping the trade ways from specific countries or regions for a time period of just under 5 years (from 1st of January 2016 to 30th of September 2020) a trade development trend can be evaluated, as well as an estimate on traded amounts.

This analysis could in turn be valuable for the members of ESMC or other actors on the global PV market scene, to use in their respective business or organisational development. By detecting the most prominent trade ways and/or the directions in which the market is developing, new or more niche markets could be identified. If not else, this analysis could function as a pre study on which markets could be of interest for future client or business expansions. In addition to the value it could bring to specific member companies, through investigating the trade flows and thus the hardware dependency of other regions, this analysis could form a basis for discussion in ESMCs work on the topic of policy development.

DATA AND METHODOLOGY

The main data source for the analysis is a data base managed by the International Trade Centre (ITC), called Trade Map. It provides detailed import and export data by annual quarters where the data availability is divided into three categories, being *No data*, *Reporting Data*, and *Mirror Data*. The *Mirror Data* is available for countries that trade goods with reporting countries, since export of a product from country X to country Y is the same as import into Y from country X. The data in question is reported to ITC by the respective countries' trading entities. The nature of the reporting system could leave room for misreporting and/or differences in data quality but is considered the best available option.

Extracting the data from Trade Map is done in two main steps; being handling the import data and the export data separately and categorized by country. Inside the database, the trade is categorized under different Harmonized System (HS) codes. In this particular analysis, the data is collected inside the code 854140, with the description; *Photosensitive semi-conductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; Light emitting diodes.* This code is globally available and used in classification on all continents. This means that the trade flows presented in this analysis are not exclusively for photovoltaics, but for photosensitive semi-conductors and the content described above.

The analysis has been made on a country level where all European countries' trade have been analysed separately and then added together to form a picture of Europe's trade. This means that intercontinental trade is presented in the results as well, where trade from Germany, Italy, France, and Austria have been investigated separately while the other countries are categorised under *rest of Europe*.

A value conversion from the countries' national currencies has already been done by the national trade ministries as all data is reported in US$ in the ITC data base. Even though it would be logical to use Euros (€) when presenting the trade flows for ESMCs audience, a choice of not re-converting the data has been made to secure the accuracy of the reported amounts, as information on time of conversion and conversion rates are unknown.

TRADE WAYS

In the following chapter, the results from the customs data analysis are presented. The export regions and countries that have been analysed in relation to Europe are: China, Malaysia, South Korea, Japan, Taiwan, Rest of Asia, Africa, the Middle East, Oceania, South America, USA, rest of north America and central America, Germany, Italy, France, Austria, and rest of Europe. Appendix holds a table of the geographical categorisation. The data availability was mostly satisfactory, but a few countries lacked data, namely Albania, Kosovo and Moldova and are thereby excluded from the analysis. Additionally, Belarus, Macedonia, Montenegro, and Ukraine only had *mirror data*. They constitute the markets with highest uncertainties since trade with other countries without data cannot be traced. However, the markets with no reported data available are relatively small compared to the top markets in Europe, with Ukraine as an exception.

In Table 1, the total traded value imported to or exported from Europe is presented and the value of traded goods inside the HS code is increasing over the studied time period. It is also clear that import dominates the trade in this product and material category, indicating a hardware dependency from other regions. There is a slight lag in the reporting of data, why only parts of 2020's trade can be collected. Note that this analysis is based on all separate European countries' trade flows and that the table also includes trade between European countries. However, the following results will show that the import from trade partners outside Europe surpasses the trade between European countries with large margins, see Figure 1-3 and Table 2.

Table 1. The total value of traded *Photosensitive semi-conductor devices, including photovoltaic cells whether assembled in modules or made up into panels; Light emitting diodes* with European countries from 2016 to the third quarter of 2020. All data is presented in thousands of US$ and collected from ITC data base trademap.

	2016 [kUS$]	2017 [kUS$]	2018 [kUS$]	2019 [kUS$]	Q1-Q3 2020 [kUS$]
Import	9 576 943	9 681 906	11 691 269	14 593 980	10 648 615
Export	6 690 675	6 991 988	7 238 874	7 737 175	6 089 679

Another point worth mentioning is that the market has witnessed some price reductions during this period. Relating the declining price trend with the trend of an increasing value of traded goods could indicate an even larger ramp-up than the numbers in Table 1 suggest.

Import flows

To visualise the trade flows, they are mapped out as in figure 1-3. China was the number one exporting market into Europe, and its position has strengthened during the time period studied, from 23.6% in 2016 to 54.2% 2020. While Asia, with China in lead, has increased in importance, a declining trend can be traced in the Intereuropean trade. All numerical values are presented in Table 2 and extended with the data for years 2016 and 2017.

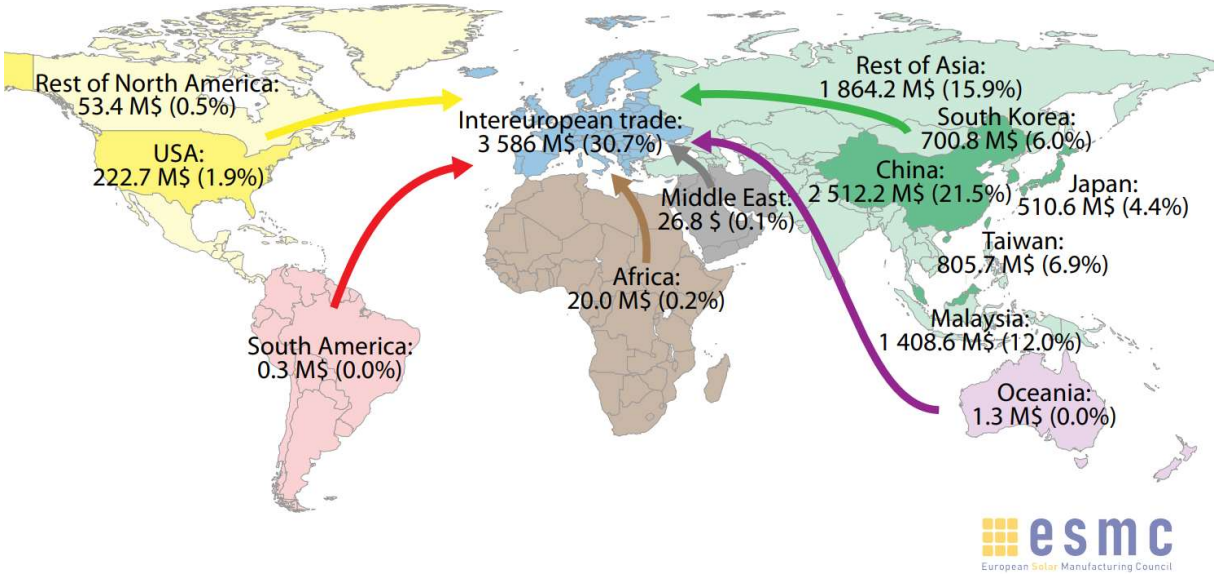

Figure 1. The largest trade flows with goods inside the HS code 854140: *Photosensitive semi-conductor devices, including photovoltaic cells whether assembled in modules or made up into panels; Light emitting diodes* into Europe in 2018.

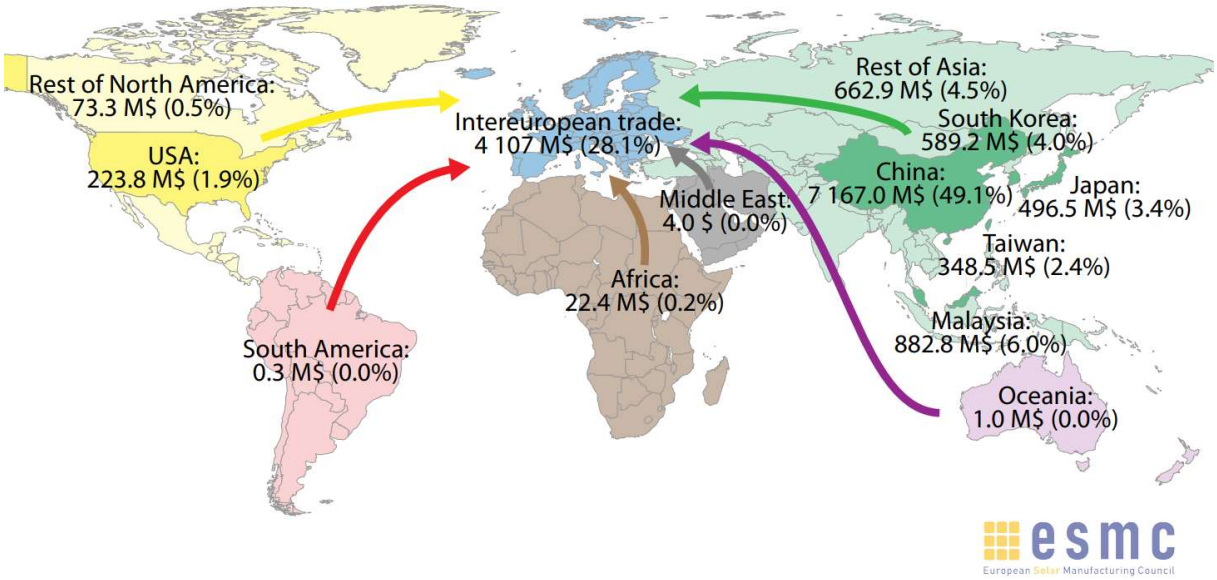

Figure 2. The largest trade flows with goods inside the HS code 854140: *Photosensitive semi-conductor devices, including photovoltaic cells whether assembled in modules or made up into panels; Light emitting diodes* into Europe in 2019.

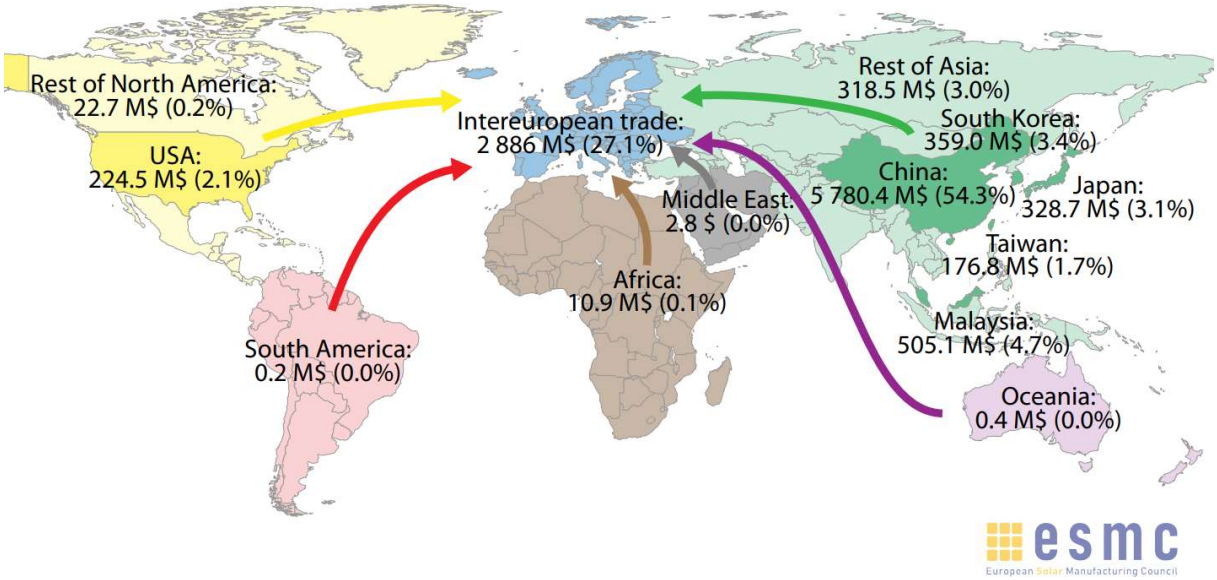

Figure 3. The largest trade flows with goods inside the HS code 854140: *Photosensitive semi-conductor devices, including photovoltaic cells whether assembled in modules or made up into panels; Light emitting diodes* into Europe in 2020.

Below in Table 2, the shares of import from all chosen markets are presented. In the categorisation for this report, Turkey and Russia are not classified as European countries, and are instead included in *Rest of Asia*. The markets that are presented as regions rather than countries (Africa, the middle East, Oceania and the Americas) seem to have a limited impact on the European import market, with steady market shares under one percent each, with the category *Rest of Asia* as an exception.

Table 2. The market shares [%] from Europe's import for each year of the studied period and the monetary value of named trade expressed in thousands of US dollars (kUS$). *N & C America* is short for North America and Central America. *R o* means Rest of.

	2016 [kUS$ (%)]	2017 [kUS$ (%)]	2018 [kUS$ (%)]	2019 [kUS$ (%)]	2020 [kUS$ (%)]
China	2 263 306 (23.6)	1 545 021 (16.0)	2 512 197 (21.5)	7 166 951 (49.1)	5 780 353 (54.3)
Malaysia	682 588 (7.1)	1 097 978 (11.3)	1 408 645 (12.0)	882 828 (6.0)	505 086 (4.7)
South Korea	252 623 (2.6)	378 479 (3.9)	700 846 (6.0)	589 181 (4.0)	359 044 (3.4)
Japan	485 439 (5.1)	477 462 (4.9)	510 617 (4.4)	496 464 (3.4)	328 716 (3.1)
Taiwan	1 352 614 (14.1)	1 114 652 (11.5)	805 705 (6.9)	348 508 (2.4)	176 825 (1.7)
Rest of Asia	943 241 (9.8)	1 477 735 (15.3)	1 864 188 (15.9)	662 850 (4.5)	318 513 (3.0)
Africa	3 595 (0.0)	13 370 (0.1)	20 044 (0.2)	22 369 (0.2)	10 929 (0.1)
The Middle East	11 337 (0.1)	28 008 (0.3)	26 849 (0.1)	4 034 (0.0)	2 791 (0.0)
Oceania	2 373 (0.0)	1 192 (0.0)	1 298 (0.0)	1 082 (0.0)	434 (0.0)
South America	406 (0.0)	759 (0.0)	317 (0.0)	282 (0.0)	220 (0.0)
USA	258 833 (2.7)	284 154 (2.9)	222 749 (1.9)	223 830 (1.5)	224 470 (2.1)
R o N & C America & the Carribean	74 254 (0.8)	65 351 (0.7)	53 367 (0.5)	73 258 (0.5)	22 665 (0.2)
Intereuropean trade	3 246 134 (33.9)	3 246 422 (33.5)	3 585 650 (30.7)	4 106 692 (28.1)	2 886 301 (27.1)

Export flows

Examining the export flows, the clearest trend is that a majority of the total exported value is Intereuropean. This could either mean that the European industry is providing the regional European market with hardware, or that several steps in the trade chain are European, or a combination of both. To draw any definitive conclusion, further studied must be made.

Another evident difference compared to the import streams is that the trade ways from Europe to Asia are not as prominent. Still comparing the two trade directions, *Africa* and *The Middle East* have appeared as new trade partner regions, see Figure 4-6 for a visual representation of the export flows.

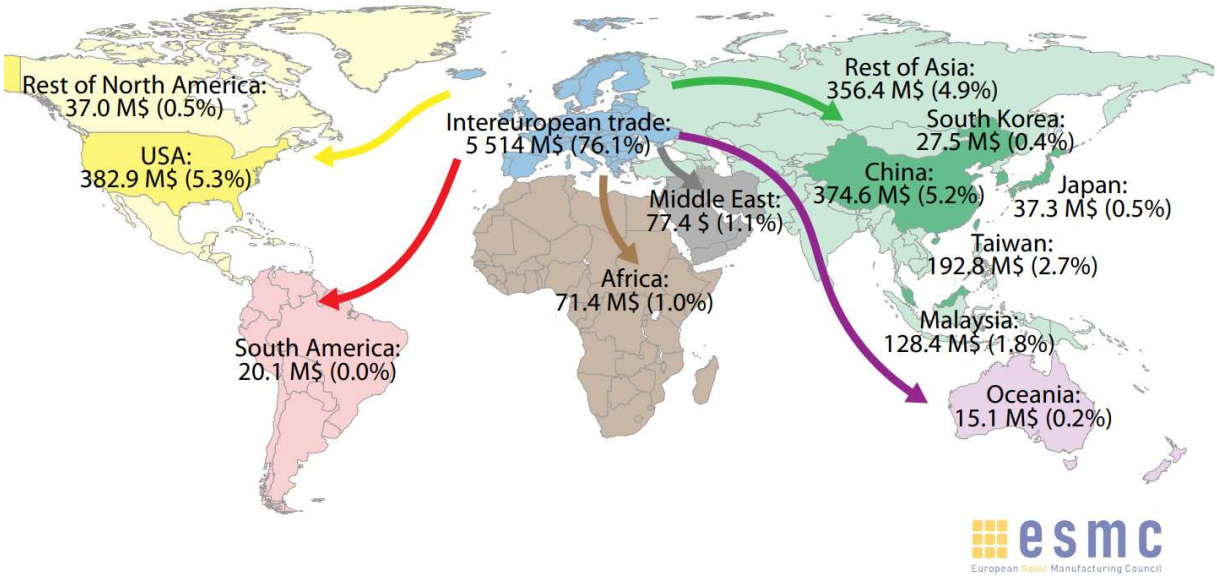

Figure 4. The largest trade flows with goods inside the HS code 854140: *Photosensitive semi-conductor devices, including photovoltaic cells whether assembled in modules or made up into panels; Light emitting diodes* exported out of Europe in 2018.

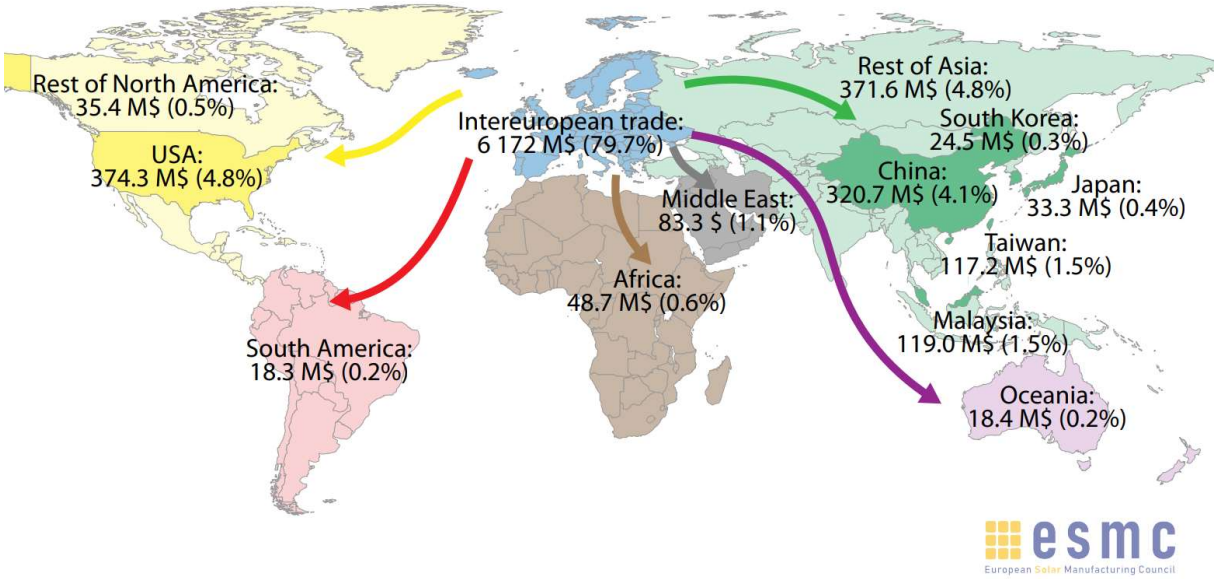

Figure 5. The largest trade flows with goods inside the HS code 854140: *Photosensitive semi-conductor devices, including photovoltaic cells whether assembled in modules or made up into panels; Light emitting diodes* exported out of Europe in 2019.

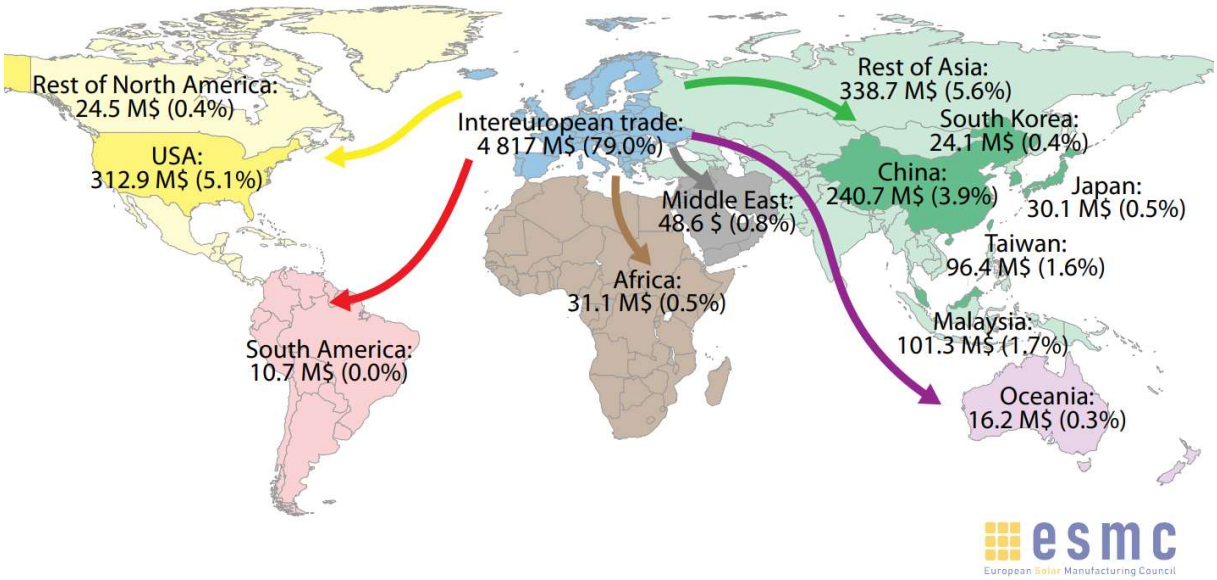

Figure 6. The largest trade flows with goods inside the HS code 854140: *Photosensitive semi-conductor devices, including photovoltaic cells whether assembled in modules or made up into panels; Light emitting diodes* exported out of Europe in 2020.

As mentioned, most of the export is traded between European countries, with Germany as a regional leader just as with import. The result indicates that there is some export trade with photosensitive semi-conductors between Europe and Asia, mostly China, but comparing it with the import, the amounts are small.

Table 3. The market shares [%] from Europe's export for each year of the studied period and the monetary value of named trade expressed in thousands of US dollars (kUS$). *N & C America* is short for North America and Central America. *R o* means Rest of.

	2016 [kUS$ (%)]	2017 [kUS$ (%)]	2018 [kUS$ (%)]	2019 [kUS$ (%)]	2020 [kUS$ (%)]
China	349 009 (5.2)	354 662 (5.1)	374 552 (5.2)	320 708 (4.1)	240 669 (3.9)
Malaysia	184 649 (2.8)	161 041 (2.3)	128 367 (1.8)	119 031 (1.5)	101 298 (1.7)
South Korea	23 774 (0.4)	23 717 (0.3)	27 476 (0.4)	24 538 (0.3)	24 058 (0.4)
Japan	67 751 (1.0)	35 684 (0.5)	37 261 (0.5)	33 260 (0.4)	30 073 (0.5)
Taiwan	50 890 (0.8)	163 570 (2.3)	192 754 (2.7)	117 196 (1.5)	96 361 (1.6)
Rest of Asia	231 995 (3.5)	228 359 (3.3)	356 417 (4.9)	371 607 (4.8)	338 688 (5.6)
Africa	55 174 (0.8)	67 675 (1.0)	71 437 (1.0)	48 731 (0.6)	31 052 (0.5)
The Middle East	91 529 (1.4)	99 812 (1.4)	77 401 (1.1)	83 317 (1.1)	48 559 (0.8)
Oceania	12 525 (0.2)	15 021 (0.2)	15 114 (0.2)	18 356 (0.2)	16 205 (0.3)
South America	15 428 (0.2)	22 615 (0.3)	20 145 (0.3)	18 281 (0.2)	10 692 (0.2)
USA	552 158 (8.2)	436 935 (6.2)	382 930 (5.3)	374 328 (4.8)	312 935 (5.1)
R o N & C America & the Carribean	66 751 (1.0)	36 515 (0.5)	37 002 (0.5)	35 437 (0.5)	24 511 (0.4)
Intereuropean trade	4 989 042 (74.5)	5 350 049 (76.5)	5 513 785 (76.1)	6 171 691 (79.7)	4 817 170 (79.0)

SUMMARY

Concluding the analysis, there are two clear trends in the import and the export respectively. Firstly, the largest amounts are imported from the Asian region, especially from China and the Asian market share is growing under the examined period.

In terms of export, a much clearer regional trade behaviour can be traced. Even though the shares are still small, some additional export to *Africa* and *The Middle East* can be detected, as well as to the Americas, where USA holds a majority share.

APPENDIX- ADDITIONAL TABLES

Presented below are the countries categorised into regions or continents. All trade in or out of Europe from or to all countries mentioned in the table have been analysed specifically. The countries that are part of a region have then been summarised for presentation purposes because of their limited share of the total trade.

Table A.1. The categorisation of countries inside and outside of Europe used in this analysis. All countries that are not mentioned in this table are categorized under *Rest of World*.

Country or region	Specified; the classification of the different Regions
China	China, Hong Kong
Malaysia	
South Korea	
Japan	
Taiwan	
Rest of Asia	India, Afghanistan, Bangladesh, Bhutan, British Indian Ocean Territory, Brunei Darussalam, Cambodia, Christmas Island, Cocos (Keeling) Islands, Indonesia, Kazakhstan, North Korea, Kyrgyzstan, Lao, Macao, Maldives, Mongolia, Myanmar, Nepal, Pakistan, Philippines, Russian Federation, Singapore, Sri Lanka, Tajikistan Thailand, Timor-Leste, Tukey, Turkmenistan, Uzbekistan & Viet Nam
Africa	Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mayotte, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Saint Helena, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Tanzania, Togo, Tunisia, Uganda, Western Sahara, Zambia & Zimbabwe
The Middle East	Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Palestine (West Bank and Gaza Strip), Qatar, Saudi Arabia, Syria, United Arab Emirates & Yemen
Oceania	American Samoa, Australia, Cook Islands, Fiji, French Southern and Antarctic Territories, Guam, Kiribati, Marshall Islands, Micronesia, Nauru, New Caledonia, New Zealand, Niue, Norfolk Island, Northern Mariana Islands, Palau, Papua New Guinea, Pitcairn, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu & Wallis and Futuna Islands
South America	Argentina, Bolivia, Sint Eustatius and Saba Bonaire, Brazil, British Antarctic Territory, Chile, Colombia, Ecuador, Faroe Islands, French Polynesia, Guyana, Netherlands Antilles, Paraguay, Peru, Suriname, Uruguay & Venezuela
USA	
Rest of North America & Central America & the Caribbean	Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, British Virgin Islands, Cayman Islands, Cuba, Curaçao, Dominica, Grenada, Haiti, Jamaica, Montserrat, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Sint Maarten (Dutch part), St. Pierre and Miquelon, Trinidad and Tobago, Turks and Caicos Islands, Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Bermuda, Canada, Greenland, Mexico, United States Minor Outlying Islands
Rest of Europe	Germany, Italy, France, Austria, Albania, Andorra, Armenia, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Georgia, Gibraltar, Greece, Hungary, Iceland, Ireland, Latvia, Lithuania, Luxembourg, North Macedonia, Malta, Moldova, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom & Bouvet Island