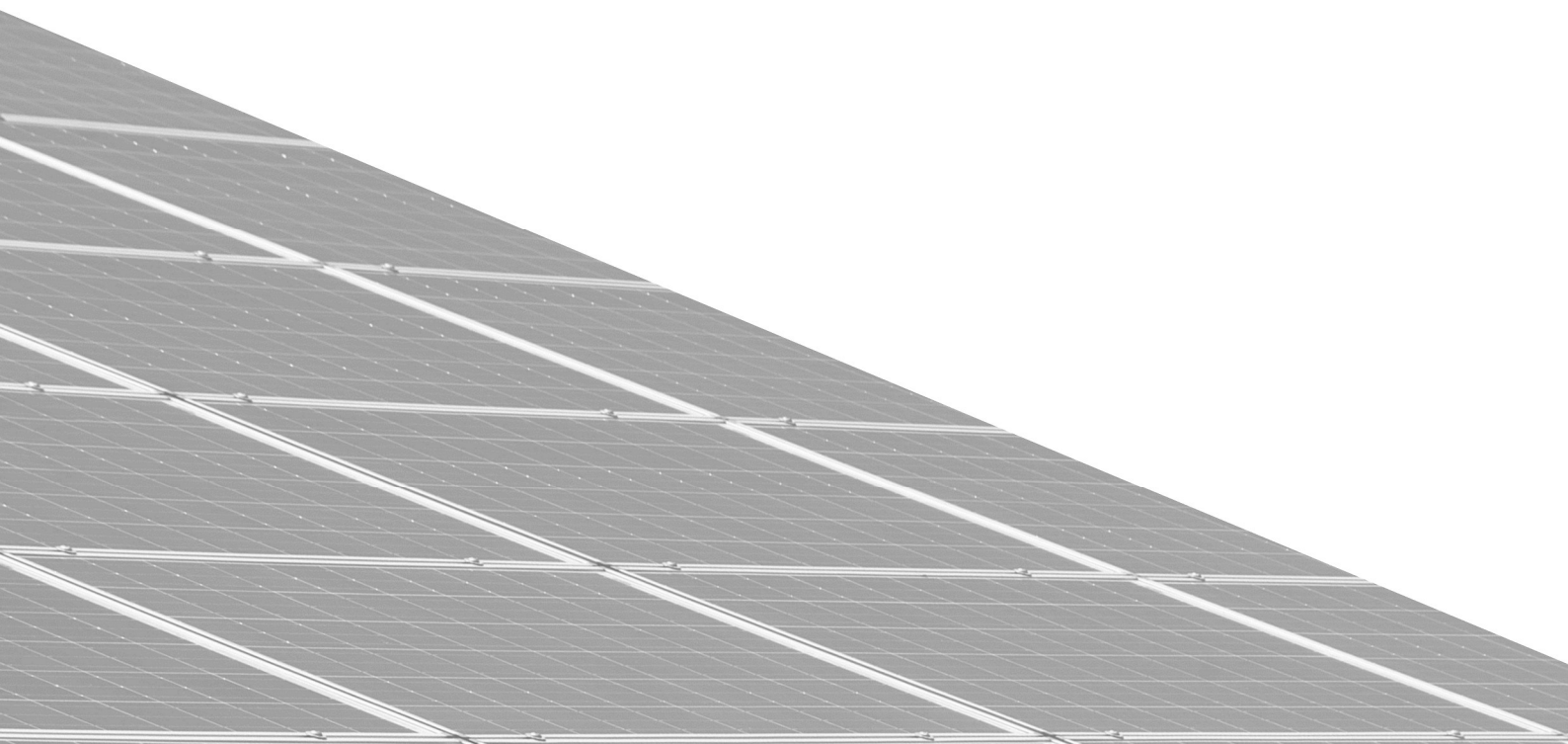
DOMINANT PV TRADE FLOWS IN EUROPE

- A customs data analysis performed by the European Solar Manufacturing Council

The European Solar Manufacturing Council (ESMC) is the organisation representing the interests of the European PV manufacturing industry. ESMC aims at promoting and supporting the PV manufacturing industry and its value chains at the European level, by creating a supportive political environment.

This study has been conducted by Amelia Oller Westerberg and Johan Lindahl. Any questions regarding the analysis or requests for additional information can be handled through lindahl@esmc.solar.



BRIEF BACKGROUND AND AIM

Europe held a majority share of both market and industry during the first years of the global PV development. With time, other parts of the world, with China in the lead, started gaining larger market shares in terms of both installation and manufacturing volumes. At the end of 2021, the European Union was the second largest market in terms of cumulative and annual capacity after China, with three individual markets in the top 10 of annual installations, namely Germany, Spain, and Poland in places 5, 8, and 10.

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 and by mapping the trade ways from specific countries or regions for a period of 4 years (2018 to 2021), a trade development trend can be evaluated, as well as an estimate of traded amounts. In addition to the value that it could bring to specific member companies, through investigating the trade flows and thus the hardware dependency of other regions, this analysis forms a basis for discussion in ESMC's work on policy development and the continuous contact with the European Commission and national governments.

DATA AND METHODOLOGY

The data source for the analysis is a database managed by the International Trade Centre (ITC), called Trade Map. It provides detailed monthly import and export data. 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.

Inside the database, the data is divided into different Harmonized System (HS) codes. In this particular analysis, the data is collected in the hierarchy below 6-digit HS code 854 140, with the description; *Photosensitive semi-conductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; Light emitting diodes.* As sub-categories under this code, market-specific 10-digit National tariff line (NTL) codes exist with a higher level of detail on the content. The 10-digit codes have been used in this analysis to exclude the trade of photosensitive semiconductors that are not photovoltaics, which in this is case mainly LED. In cases where a country doesn't have any 10-digit code, the 6-digit code has been used instead.

The analysis has been made on a country level where all countries' trade has been analysed separately and then added together to form a picture of Europe's trade. 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 database. Even though it would be logical to use Euros (€) when presenting the trade flows, a choice to not re-convert the data has been made to secure the accuracy of the reported amounts, as information on the 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 are presented in relation to Europe are: China, Malaysia, South Korea, Japan, Taiwan, Rest of Asia, Africa, the Middle East, Oceania, South America, USA and the rest of North America & Central America. 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. These countries are thus excluded from the analysis. Additionally, Belarus, Macedonia, Montenegro, and Ukraine only had mirror data. They constitute the markets with the highest uncertainties since trade with other countries without direct 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.

Table 1 presents the total traded value imported to or exported from Europe. The analysis is based on all separate European countries' trade flows, where their respective trade with other European countries has been excluded (both import and export).

Imports clearly dominate the trade in this product category, indicating a hardware dependency from other regions. Results show that the imbalance between Extraeuropean import and export has increased with 197% (7.55 billion US$) in total monetary value between 2018 and 2021. In relative terms, Europe exported a value amounting to 21 % of its imports in 2018, which decreased to 13 % in 2019. It increased to 21% again in 2020 and ultimately decreased to 14 % in 2021. The trade balance in Table 1 clearly shows that as the market is growing, Europe is becoming more import-dependent.

Table 1. The total value of traded photovoltaics cells and modules with European countries from 2018 to 2021. All data is presented in millions of US$ and collected from ITC data base trademap.

	2018 [US$, billions]	**2019** [US$, billions]	**2020** [US$, billions]	**2021** [US$, billions]
Extra-European import	4.87	7.87	8.94	13.20
Extra-European export	1.04	1.00	1.60	1.82
Trade balance	**-3.84**	**-6.87**	**-7.33**	**-11.39**

Table 2 shows the Intereuropean trade based on export data, where all countries' separate trade with other European countries has been summarised. Note that re-distribution of modules and cells between countries in the Single Market is to be expected and that the values shown in Table 2 likely partially include values already accounted for once in Table 1.

However, it clearly shows that the Internal European Market is strong and that a majority of the countries' export is Intereuropean, which captures the interregional manufacturing volumes. Even if it likely captures some of the externally imported modules and cells, it is evident that the extraeuropean import amounts to much more than the internally traded value

Table 2. The total value of internally traded photovoltaic cells and modules from 2018 to 2021 registered in ITC database trademap. All data is presented in billions of US$.

	2018 [US, billions]	**2019** [US, billions]	**2020** [US, billions]	**2021** [US, billions]
Inter-European trade	2.80	4.84	5.53	8.10

Import flows

To visualize the trade flows, they are mapped out in Figures 1-4. China was the number one exporting market into Europe, and its position strengthened during the studied time-period, from 26.5% in 2018 to 88.2% 2021.

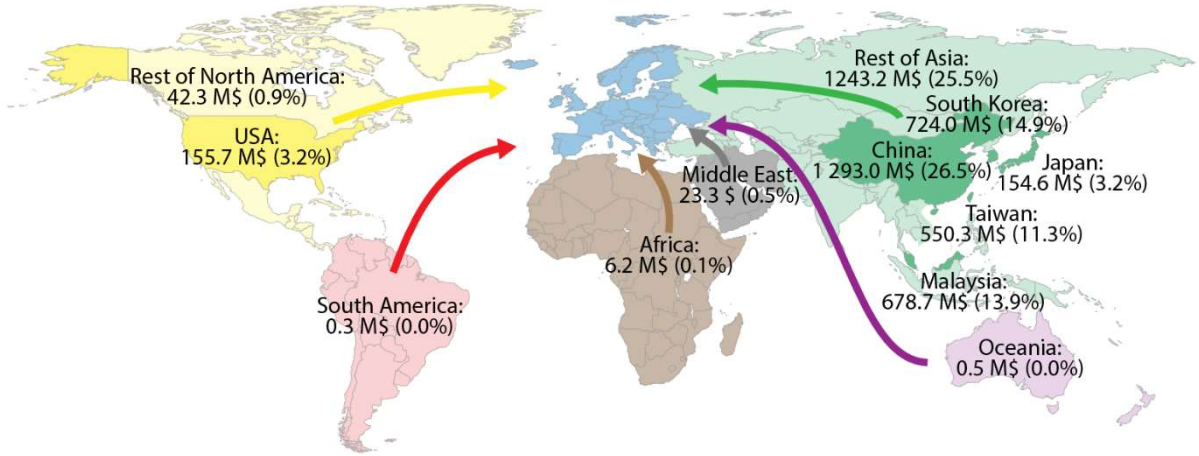


Figure 1. The largest import trade flows with goods inside the NTL-codes of European countries, with a few expectations of the HS code 854140: *Photosensitive semi-conductor devices, including photovoltaic cells whether assembled in modules or made up into panels; Light emitting diodes* into Europe in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

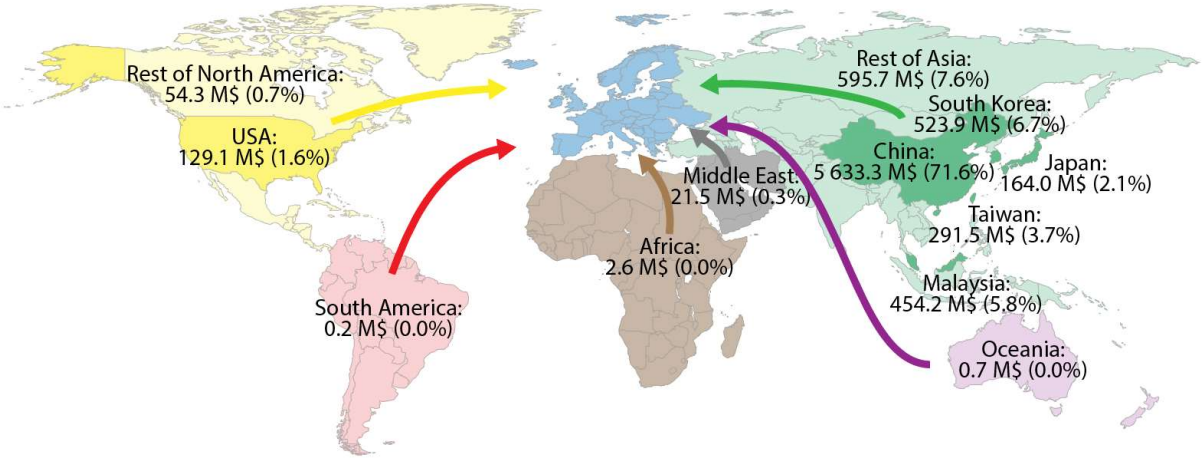


Figure 2. The largest import trade flows with goods inside the NTL-codes of European countries, with a few expectations of the HS code 854140: *Photosensitive semi-conductor devices, including photovoltaic cells whether assembled in modules or made up into panels; Light emitting diodes* into Europe in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

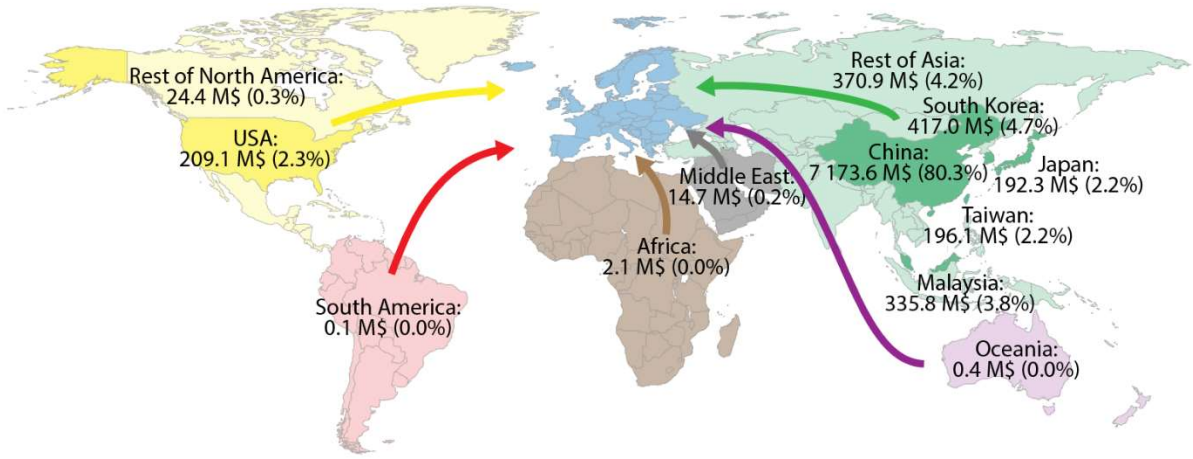


Figure 3. The largest import trade flows with goods inside the NTL-codes of European countries, with a few expectations of the HS code 854140: *Photosensitive semi-conductor devices, including photovoltaic cells whether assembled in modules or made up into panels; Light emitting diodes* into Europe in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

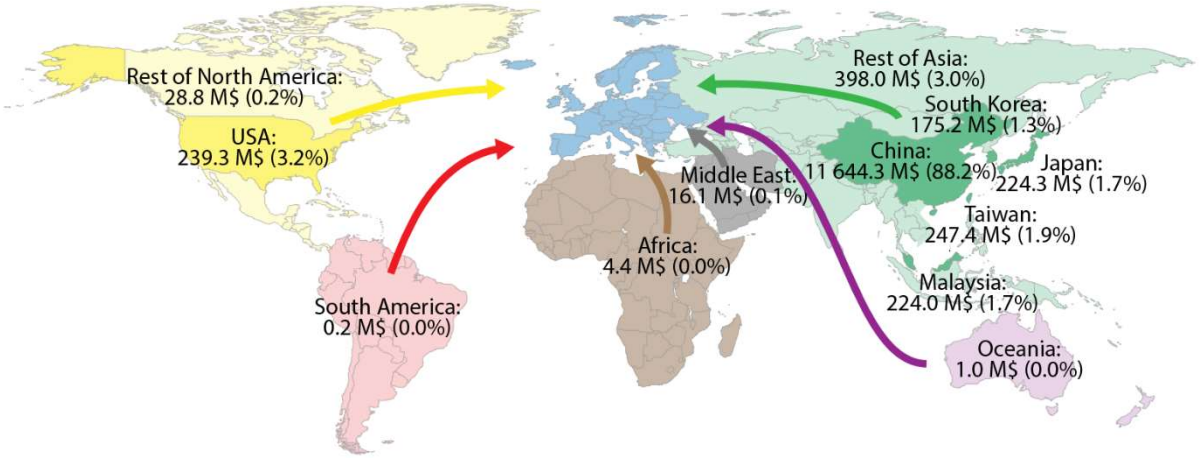


Figure 4. The largest import trade flows with goods inside the NTL-codes of European countries, with a few expectations of the HS code 854140: *Photosensitive semi-conductor devices, including photovoltaic cells whether assembled in modules or made up into panels; Light emitting diodes* into Europe in 2021.

Below in Table 3, the shares of import from all chosen markets are presented. In the categorization 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 3.2 percent and the category *Rest of Asia* as an exception.

Table 3. The imported value [MUS$] and the share [%] of the total import to Europe's import for each year and export region or country, *N & C America* is short for North America and Central America. *R o* means Rest of.

	2018 [US, millions, (%)]	**2019** [US, millions, (%)]	**2020** [US, millions, (%)]	**2021** [US, millions, (%)]
China	1 293.0 (26.5)	5 633.3 (71.6)	7 173.6 (80.3)	11 644.3 (88.2)
Malaysia	678.7 (13.9)	454.2 (5.8)	335.8 (3.8)	224.0 (1.7)
South Korea	724.0 (14.9)	523.9 (6.7)	417.0 (4.7)	175.2 (1.3)
Japan	154.6 (3.2)	164.0 (2.1)	192.3 (2.2)	224.3 (1.7)
Taiwan	550.3 (11.3)	291.5 (3.7)	196.1 (2.2)	247.4 (1.9)
Rest of Asia	1 243.2 (25.5)	595.7 (7.6)	370.9 (4.2)	398.0 (3.0)
Africa	6.2 (0.1)	2.6 (0.0)	2.1 (0.0)	4.4 (0.0)
The Middle East	23.3 (0.5)	21.5 (0.3)	14.7 (0.2)	16.1 (0.1)
Oceania	0.5 (0.0)	0.7 (0.0)	0.4 (0.0)	1.0 (0.0)
South America	0.3 (0.0)	0.2 (0.0)	0.1 (0.0)	0.2 (0.0)
USA	155.7 (3.2)	129.1 (1.6)	209.1 (2.3)	239.3 (1.8)
R o N C America & Caribbean	42.3 (0.9)	54.3 (0.7)	24.4 (0.3)	28.8 (0.2)
Total	4 872.0	7870.9	8936.7	13 202.9

Export flows

As presented in Table 3, a clear trend is that most of the European countries' 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 most probably, a combination of both.

The United States of America is the single largest importer from Europe, while the export streams to Asia are still prominent in terms of share, while the amounts are evidently smaller. Still comparing the two trade directions. *Africa* and *The Middle East* have appeared as new trade partner regions. see Figure 5-8 for a visual representation of the export flows.

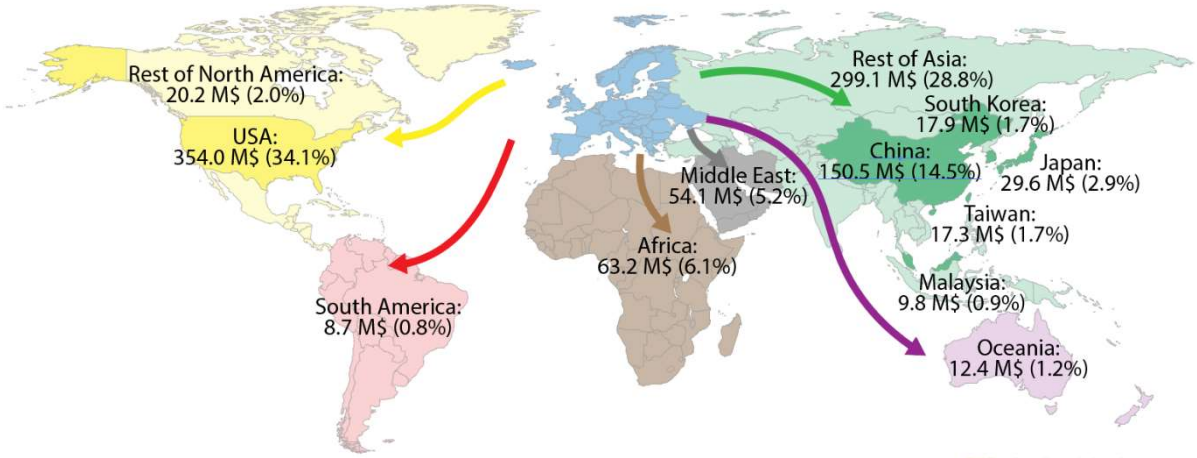


Figure 5. The largest export trade flows with goods inside the NTL-codes of European countries. with a few expectations of the HS code 854140: *Photosensitive semi-conductor devices. including photovoltaic cells whether assembled in modules or made up into panels; Light emitting diodes* out of Europe in 2018.

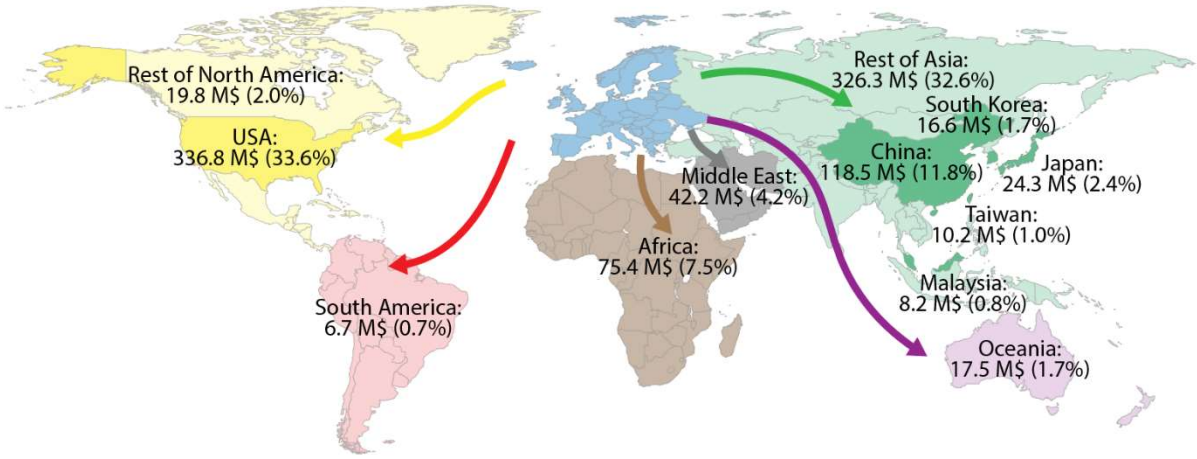


Figure 6. The largest export trade flows with goods inside the NTL-codes of European countries. with a few expectations of the HS code 854140: *Photosensitive semi-conductor devices. including photovoltaic cells whether assembled in modules or made up into panels; Light emitting diodes* out of Europe in 2019.

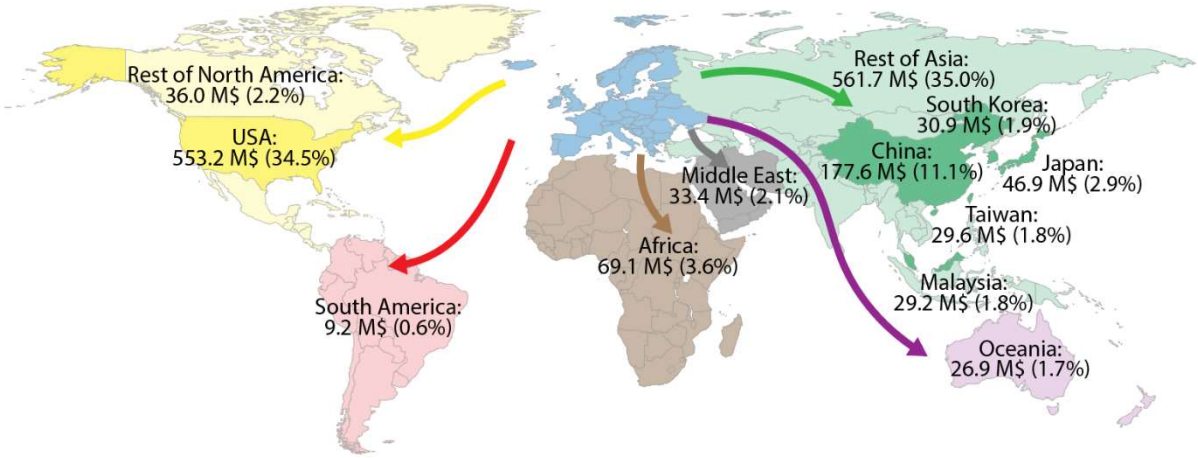


Figure 7. The largest export trade flows with goods inside the NTL-codes of European countries. with a few expectations of the HS code 854140: *Photosensitive semi-conductor devices. including photovoltaic cells whether assembled in modules or made up into panels; Light emitting diodes* out of Europe in 2020.

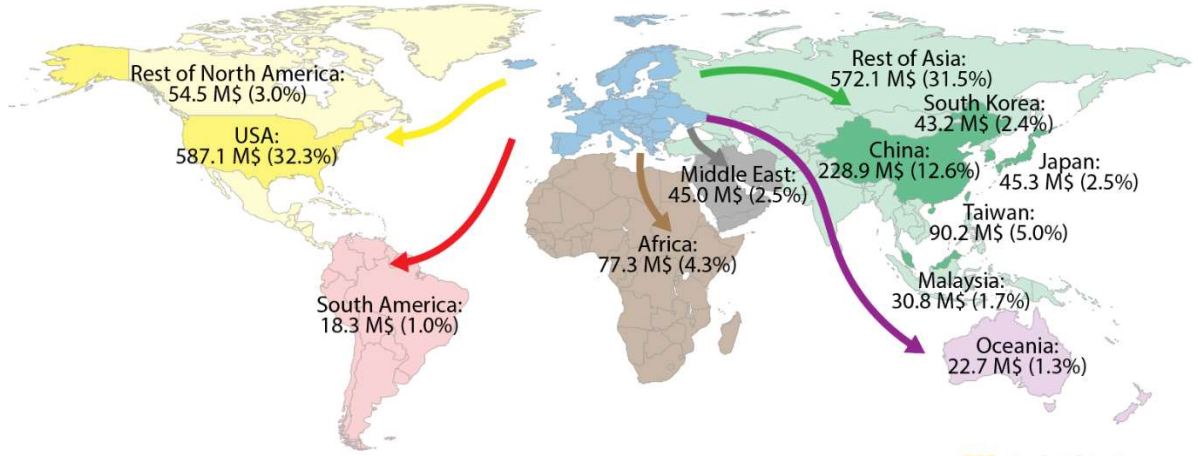


Figure 8. The largest export trade flows with goods inside the NTL-codes of European countries. with a few expectations of the HS code 854140: *Photosensitive semi-conductor devices. including photovoltaic cells whether assembled in modules or made up into panels; Light emitting diodes* out of Europe in 2021.

Below in Table 4, the shares of export to all chosen markets are presented.

Table 4. The exported value [MUS$] and the share [%] of the total import to Europe's export for each year and import region or country. *N & C America* is short for North America and Central America. *R o* means Rest of.

	2018 [US, millions, (%)]	**2019** [US, millions, (%)]	**2020** [US, millions, (%)]	**2021** [US, millions, (%)]
China	150.5 (14.5)	118.5 (11.8)	177.6 (11.1)	228.9 (12.6)
Malaysia	9.8 (0.9)	8.2 (0.8)	29.2 (1.8)	30.8 (1.7)
South Korea	17.9 (1.7)	16.6 (1.7)	30.9 (1.9)	43.2 (2.4)
Japan	29.6 (2.9)	24.3 (2.4)	46.9 (2.9)	45.3 (2.5)
Taiwan	17.3 (1.7)	10.2 (1.0)	29.6 (1.8)	90.2 (5.0)
Rest of Asia	299.1 (28.8)	326.3 (32.6)	561.7 (35.0)	572.1 (31.5)
Africa	63.2 (6.1)	75.4 (7.5)	69.1 (4.3)	77.3 (4.3)
The Middle East	54.1 (5.2)	42.2 (4.2)	33.4 (2.1)	45.0 (2.5)
Oceania	12.4 (1.2)	17.5 (1.7)	26.9 (1.7)	22.7 (1.3)
South America	8.7 (0.8)	6.7 (0.7)	9.2 (0.6)	18.3 (1.0)
USA	354.0 (34.1)	336.8 (33.6)	553.2 (34.5)	587.1 (32.3)
R o N C America & Caribbean	20.2 (2.0)	19.8 (2.0)	36.0 (2.2)	54.5 (3.0)
Total	1 036.9	1 002.4	1 603.6	1 815.9

Summary

Concluding the analysis of the import streams to Europe, the largest amounts are imported from Asian countries, especially from China. The import is also increasing, both in absolute terms and in relation to Europe's export market.

In terms of export, a substantial interregional trade behaviour can be traced. The Interregional export exceeds the Extraeuropean export. It signals that a significant amount of the created value inside Europe likely stays in Europe and that imported PV products are likely redistributed amongst European countries.

Even though the shares are still small, some export to *Africa* and *The Middle East* can be detected, as well as to the Americas. The United States of America is identified as the single largest import nation.

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 individually. 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	Afghanistan, Armenia, Azerbaijan, Bangladesh, Bhutan, Brunei, Cambodia, East Timor, Georgia, India, Indonesia, Kazakhstan, Kyrgyzstan, Laos, Maldives, Mongolia, Myanmar, Nepal, North Korea, Pakistan, Philippines, Russia, Singapore, Sri Lanka, Tajikistan, Thailand, Turkey, Turkmenistan, Uzbekistan & Vietnam
Africa	Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo Democratic Republic, Côte d'Ivoire, Djibouti, Dominican Republic, Egypt, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Tanzania, Togo, Tunisia, Uganda, 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	Australia, Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, New Zealand, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu & Vanuatu
South America	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, French Guiana, Guyana, Paraguay, Peru, Suriname, Uruguay & Venezuela
USA	
Rest of North America & Central America & the Caribbean	Mexico, Canada, Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua & Panama
Rest of Europe	Albania, Andorra, Austria, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Holy See, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Moldova, Monaco, Montenegro, Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine & United Kingdom
Rest of World	All countries not specifically mentioned