Economic Brief

The CAREC Region's Increasing Trade in Low Carbon Technology

–A Reflection of the New Wave of Electrification and Electric Mobility

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The economic brief was authored by Dr. Hans Holzhacker, consultant at the CAREC Institute.

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Introduction

Trade in low-carbon technology (LCT) products plays a pivotal role in supporting global efforts to green economies and achieve climate goals. International trade in LCT helps countries to obtain the tools needed for advanced electrification, decarbonization, and energy efficiency.

Discussions about the role of trade and trade facilitation for the greening of economies have gone on for several decades now. An example is the World Trade Organization's (WTO's) attempt to achieve an Environmental Goods Agreement (EGA). Negotiations involved 46 WTO members. They attempted to reach an agreement based on a list of 54 environmental goods identified by the Asia-Pacific Economic Cooperation (APEC) forum in 2012. However, the negotiations failed due to conflicting interests and the lack of agreement between the US, the EU, and the PRC over certain goods, for example, bicycles.

At same time, new decarbonization initiatives in international trade such as the EU's Carbon Border Adjustment Mechanism (CBAM), which will impose tariffs on the embedded carbon in imported products after 1 January 2026, and the PRC's national ETS, launched in 2021 and envisaged to be tightened in 2026, underline the importance of low-carbon-tech trade for the CAREC region's preparation for the evolving international low-carbon economic environment.

This Economic Brief intends to shed light on the state of the CAREC[1] region's LCT trade by analyzing the related data against the background of how trade in LCT products developed globally during the last 20 years. The brief discusses LCT exports and imports in value terms and as shares of LCT in overall trade and attempts to trace the main LCT product groups traded internationally and in the CAREC region.

The brief shows that the LCT shares in global trade have substantially risen over the last two decades while the product mix has changed towards electricity-related technologies, and in particular towards batteries and electric vehicles (EVs). The People's Republic of China (PRC) is a major driver of this development. On the import side, the increase in the LCT ratio and the move towards EV trade also applies to the CAREC region. However, on the export side, the CAREC region's (other than the PRC) LCT ratios and LCT export values have remained rather low.

The new wave of electrification of the CAREC region will further increase its LCT trade in the coming years. And the imminent local EV production and assembly have the capacity to increase the CAREC region's LCT trade even on the export side. Utilizing the region's huge critical minerals potential, and its production capacities in metals such as copper, could help to further localize LCT production, if mining and downstream production further develop.

For how fast the CAREC region's low-carbon-transition can evolve and how smooth the transition will be economically and socially, public policies in support of low-carbon-tech trade will crucially matter. Engaging with foreign investors, providing infrastructure and training for local suppliers, perhaps some

[1] The Central Asia Regional Economic Cooperation (CAREC) Program is a partnership of 11 countries and development partners working together to promote development through cooperation, leading to accelerated economic growth and poverty reduction. The CAREC countries are Afghanistan, Azerbaijan, the People's Republic of China, Georgia, Kazakhstan, the Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan. https://www.carecprogram.org/?page_id=31

well-crafted local content policies, the setting of technical standards, trade facilitation measures related to LCT trade, and scaling up production through enhanced intra-regional trade will be needed to support the CAREC region's LCT production and exports.

Definition of low-carbon technology products in international trade

There are several definitions of low-carbon technology in international trade. The European Commission's Knowledge4Policy, for example, defines low-carbon technology as "carbon reduction technology, carbon-free technology, carbon removal technology, carbon management technology, resource-saving and recycling technology"[2]. For the World Economic Forum, Alexander Sauer, Director of the Institute for Energy Efficiency in Production (EEP), defines LCTs as "innovative technical solutions that are characterized by a low emission intensity, compared to state of the art alternatives. In a way, they can be seen as best-in-class technologies with a focus on environmental impact"[3]. The IMF sees LCT products as "products that produce less pollution than their traditional energy counterparts, and will play a vital role in the transition to a low carbon economy"[4]. The IMF also provides a full list of 6-digit Harmonized System (HS)[5] codes for tracking down LCT products in international trade (see the annex). The IMF's LCT products definition is largely based on Pigato et al (2020); their paper in turn utilizes the "Asia-Pacific Economic Cooperation List of Environmental Goods (APEC54)", which the Asia-Pacific Economic Cooperation (APEC) members endorsed in 2012, the World Bank Group's "Climate-Friendly and Clean-Energy Technologies List (WBG43)" of 2008, and the "List of Climate Change–Related Technologies (GDD30)" by Glachant et al (2013).

Despite the limitations the HS codes have for defining LCT products, this brief follows the IMF methodology and uses the HS code list provided by the IMF. Limitations include that the HS codes may not be able to correctly differentiate between commodities that are and that are not LCT products. For example, the 6-digit code "870340 - Vehicles; with both spark-ignition internal combustion reciprocating piston engine and electric motor for propulsion, incapable of being charged by plugging to an external source of electric power" doesn't fully exclude carbon emissions. Or the code "847420 - Machines; for crushing or grinding earth, stone, ores or other mineral substances" might include carbon emitting machines. Other difficulties are asymmetric reporting of exporting and importing countries, in part caused by time lags due to delivery, not full reporting of re-exports, etc.

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[2] European Commission, Supporting policy with scientific evidence, Glossary item, Apr 2024; Low-carbon technology https://knowledge4policy.ec.europa.eu/glossary-item/low-carbon-technology_en

[3] WEF, What are low-carbon emitting technologies? An expert explains, Feb 2022, https://www.weforum.org/stories/2022/02/what-are-low-carbon-emitting-technologies-an-expert-explains/

[4] IMF, Trade in Low Carbon Technology Products, https://climatedata.imf.org/documents/e46085cc97e445bb9c69e7de3bffbbac/explore

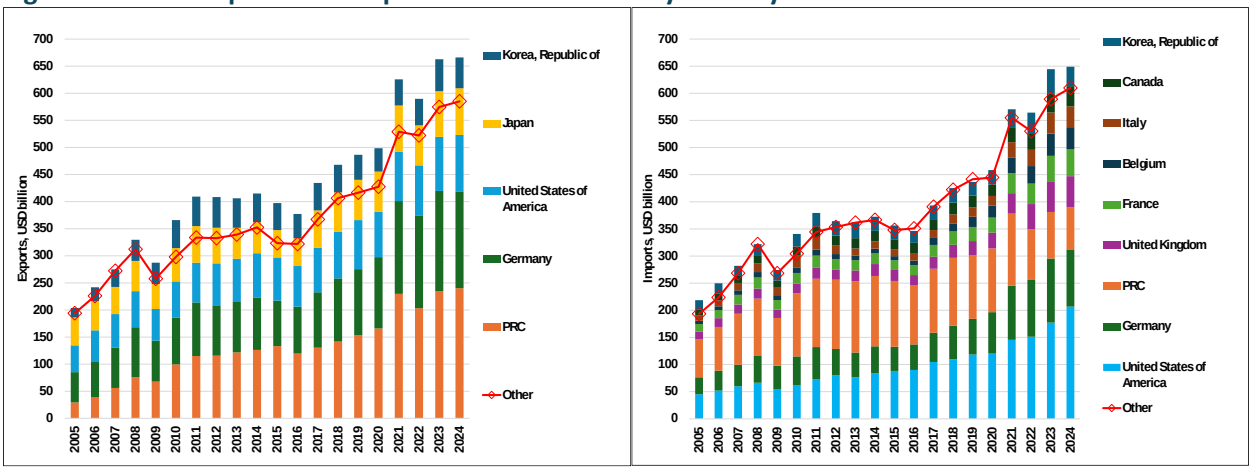
[5] "The Harmonized Commodity Description and Coding System, generally referred to as "Harmonized System" or simply 'HS', is a multipurpose international product nomenclature developed by the World Customs Organization (WCO). It comprises more than 5,000 commodity groups; each identified by a six-digit code, arranged in a legal and logical structure and is supported by well-defined rules to achieve uniform classification. The system is used by more than 200 countries and economies as a basis for their Customs tariffs and for the collection of international trade statistics. Over 98 % of the merchandise in international trade is classified in terms of the HS." https://www.wcoomd.org/en/topics/nomenclature/overview/what-is-the-harmonized-system.aspx

While recognizing its limitations, the brief sticks to the code list provided by the IMF. Given the insufficient distinction between carbon- and low-carbon-tech, the data presented in the brief might slightly overestimate the share of LCT in overall trade. HS 8- or 10-digit codes would allow a more precise identification. However, below the 6-digit level, the HS codes are not harmonized across countries and thus cannot be used to estimate LCT products for global or regional aggregations. Therefore the brief uses the IMF list but acknowledges that future more detailed research might somewhat alter the results.

Global trade in LCT products

Global trade in LCT products has increased substantially during the last two decades. The value of global trade in LCT products went from roughly USD 400 billion in 2005 to about USD 1250 billion in 2024 (Figure 1). This is growth by more than 200% at current USD prices. The PRC, Germany, the USA, Japan, and the Republic of Korea together exported LCT products at a value of more than USD 650 million in 2024, the rest of the world slightly less than USD 600 million (Figure 1, left-hand-chart). Germany, the PRC, the UK, France, Belgium, Italy, Canada, and the Republic of Korea were the main consumers, accounting together for about USD 650 million of imports in 2024, the rest of the world slightly more than USD 600 million (Figure 1, right-hand-chart).

Figure 1. Global Exports and Imports of LCT Products by Country



Source: TradeMap, author's calculations.

It is possible that the figures presented in this brief substantially underestimate trade flows during recent periods. Prices of many LCT products were decreasing during the period under consideration. Examples are the steep fall in the prices of solar photovoltaic modules or wind turbine prices in the recent decade. At the same time, this might not be the case for all LCT products, prices of some products might have risen substantially. A much more granular analysis - beyond the scope of this brief - would be needed to come up with accurate, constant price LCT trade flow figures. Nevertheless, to provide at least a rough impression of inflation-adjusted LCT trade flows, the brief uses the US consumer price index for deflating. Adjusted in this way, global LCT trade rose by about 95% between 2005 and 2024. This compares to an increase by 44% in global trade in all goods over the same period.

The Largest LCT exporters and main drivers of LCT trade globally were the PRC, Germany, the USA, Japan, and the Republic of Korea. Together they accounted for more than 50% of global exports in 2024 (Figure 1, left-hand-chart). All of them saw substantial growth in LCT exports between 2005 and 2024. With a rise of 719% in current USD and 411%, adjusted for US consumer price inflation, the PRC achieved the sharpest increase, followed by the Republic of Korea with growth of 227% and 104%, respectively. Germany reached growth of 219% and 99%, respectively, slightly higher than the global average. The USA, by contrast, remained at 110% and 31% substantially below the global average. The least growth was Japan, at a non-price-adjusted growth of 67% and an adjusted one of 4%. The combined other countries achieved LCT export growth of 2025 unadjusted and 88%, adjusted for US consumer price inflation, some percentage points below the global figure.

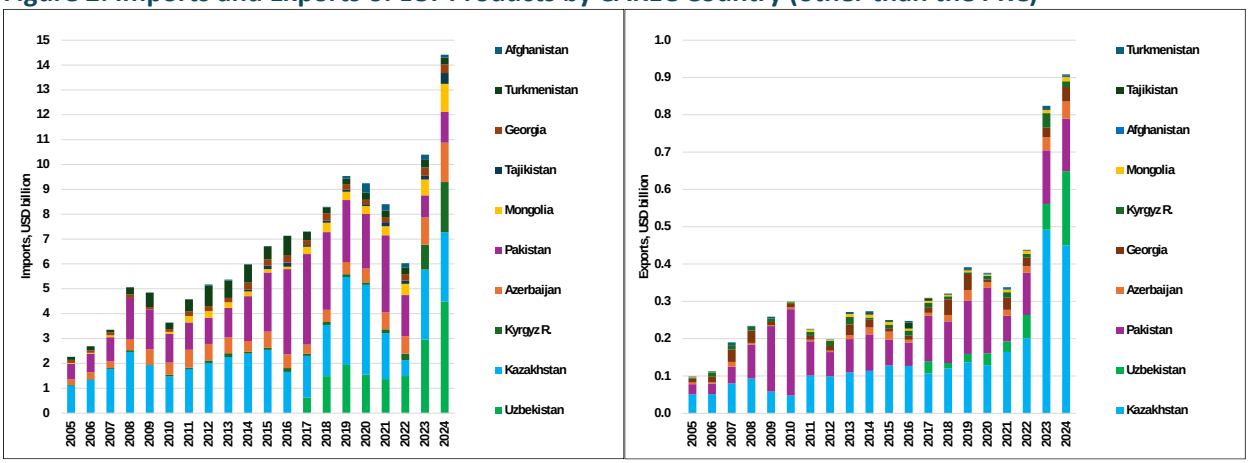
The Largest importers of LCT products were the USA, Germany, the PRC, the UK, France, Belgium, Italy, Canada, and the Republic of Korea. Together they accounted for more than 50% of global LCT imports in 2024 (Figure 1, right-hand-chart). Except for the PRC, all of them saw substantial growth in LCT imports between 2005 and 2024. Belgium's imports surged by 567% at current USD prices, and 316%, adjusted for US consumer price inflation. The USA's LCT import growth was 358% unadjusted, and 186% US inflation adjusted. Italy followed with 304% and 152%, respectively, the UK with 294% and 145%, France with 360% and 125%, Germany with 225% and 109%, and Canada with 219% and 99%. The Republic of Korea had a more moderate growth of 115% and 34%. The combined other countries saw their LCT imports increase by unadjusted 215% and by 97%, adjusted for US inflation. By contrast, the PRC had a mere 11% growth at current USD prices and a decline by 31%, adjusted for US consumer price inflation, while the PRC's imports of all goods together rose by 229% unadjusted, and by 145% US consumer price adjusted over the same period. This contrast to other countries in the growth of LCT imports can be explained by the PRC's much higher self-sufficiency in LCT in 2024 than in 2005.

Trade in LCT products by CAREC countries

The CAREC region's (other than the PRC)[6] LCT trade also increased substantially, mostly driven by imports, while the region's LCT exports are still rather low. LCT imports reached a total value of USD 14.4 billion in 2024 (Figure 2, left-hand-chart). Uzbekistan became the largest importer, followed by Kazakhstan, the Kyrgyz Republic and Azerbaijan. The LCT exports of the region had a value of USD 909 million in 2024, mostly thanks to higher exports by Kazakhstan and the Kyrgyz Republic since 2023 (Figure 2, right-hand-chart). While this is significantly higher than the amounts until 2022, it is still below USD 1 billion.

[6] Given the PRC's magnitude and very specific role in global LCT trade, the development of the PRC's trade is generally discussed under the title "global" in this brief. The developments in the CAREC region's LCT trade are discussed under the title "CAREC region (other than the PRC)", with some specific attention, however, for the PRC's role in CAREC's LCT trade.

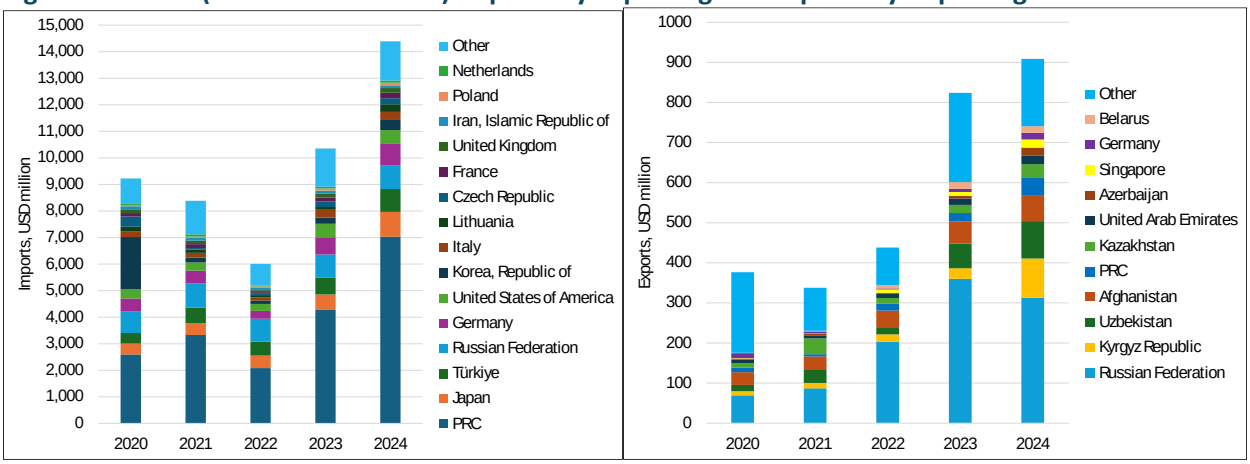
Figure 2. Imports and Exports of LCT Products by CAREC Country (other than the PRC)



Note: Values for Uzbekistan are available only since 2017.
Source: TradeMap, author's calculations.

The largest supplier of LCT products to the CAREC region by far is the PRC. The PRC provided LCT products in the amount of USD 7 billion to the CAREC region in 2024, roughly one-half of total CAREC LCT imports (Figure 3, left-hand-chart). This was followed in substantial distance by Japan, Türkiye, and the Russian Federation, with about USD 0.9 billion each. Next were Germany and the USA with USD 0.8, and 0.5 billion, respectively. Other countries supplied less than half a billion USD in LCT value in 2024.

Figure 3. CAREC (other than the PRC) Imports by Exporting and Exports by Importing Countries



Source: TradeMap, author's calculations.

The largest importer of LCT products from the CAREC region (other than the PRC) is Russia. The Russian Federation imported 34% of CAREC's LCT exports of roughly USD 900 million in 2024 (Figure 3, right-hand-chart). Then follow the Kyrgyz Republic, Uzbekistan, Afghanistan, and the PRC. Together the countries named in Figure 3 (right-hand-chart), accounted for 82% of the CAREC region's LCT exports in 2024.

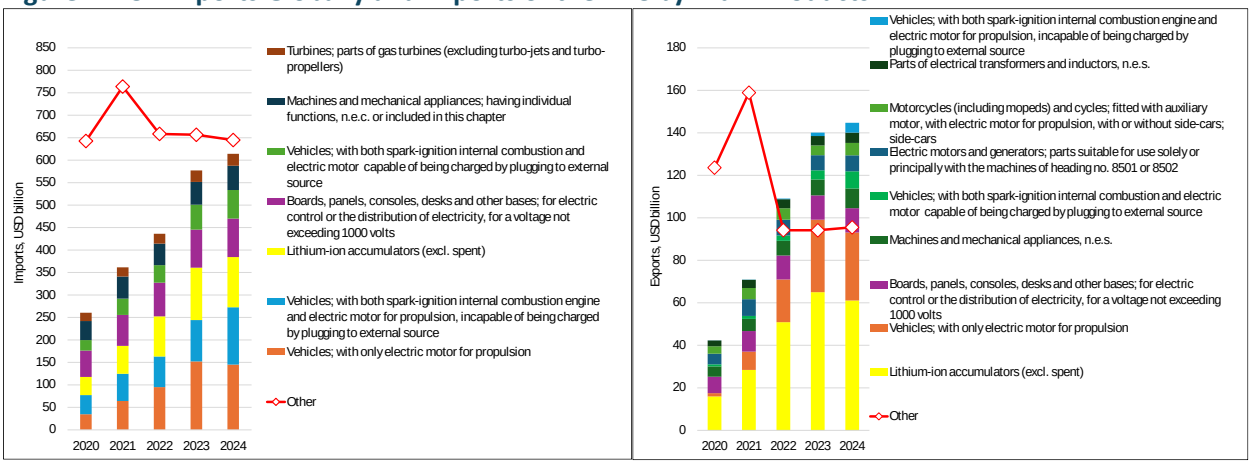
Global trade in LCT by main products

There has been a substantial change in the product composition of LCT trade globally. While the import of LCT products under the "other" HS 6-digit categories remained broadly unchanged at 650 billion USD

annually between 2020 and 2024 (Figure 4, left-hand-chart), with some peak in 2021, the import value of the seven HS categories singled out in the chart increased from USD 261 billion in 2020 to USD 614 billion in 2024, reaching 51% of the value of all LCT imports.

Especially the trade in electrical vehicles, batteries, and other electricity-related products grew fast. By 2024 the share of "vehicles with only an electric motor for propulsion" had increased to 11.5% of global LCT imports, of "vehicles; with both spark-ignition internal combustion engine and electric motor for propulsion, incapable of being charged by plugging to external source" to 10.1%, and of "vehicles with both spark-ignition internal combustion and electric motor capable of being charged by plugging to external source" to 5.0%. Together, they reached 26.7% of global LCT imports. Other strongly expanding products were "Lithium-ion accumulators (excl. spent)", accounting for 8.9% of global LCT imports in 2024, and "boards, panels, consoles, desks and other bases for electric control or the distribution of electricity, for a voltage not exceeding 1000 volts" making up 6.8% of global LCT imports in 2024.

Figure 4. LCT Imports Globally and Exports of the PRC by Main Products



Source: TradeMap, author's calculations.

The PRC has become the largest LCT exporter worldwide and a crucial provider of batteries and electrical vehicles globally. The PRC is well known for exporting electrical vehicles. However, all three electrical vehicle (EV) export categories shown in Figure 4 (right-hand-chart) accounted together for 18.6% of the PRC's LCT exports in 2024, whereas Lithium-ion accumulators[7] accounted for 25.4%. The PRC supplied 51% of global lithium-ion accumulator imports in 2024. Nevertheless, in 2024 the value of the PRC's battery exports was lower than in 2023, and the value of EV exports was higher. If the PRC continues to increase its EV production faster than other countries, it is likely that this trend will continue, and EV exports will become the PRC's dominant LCT export product. Besides EVs and batteries, electricity-related products such as boards, panels, consoles, electric motors and generators, and transformers play a major role in the PRC's LCT exports.

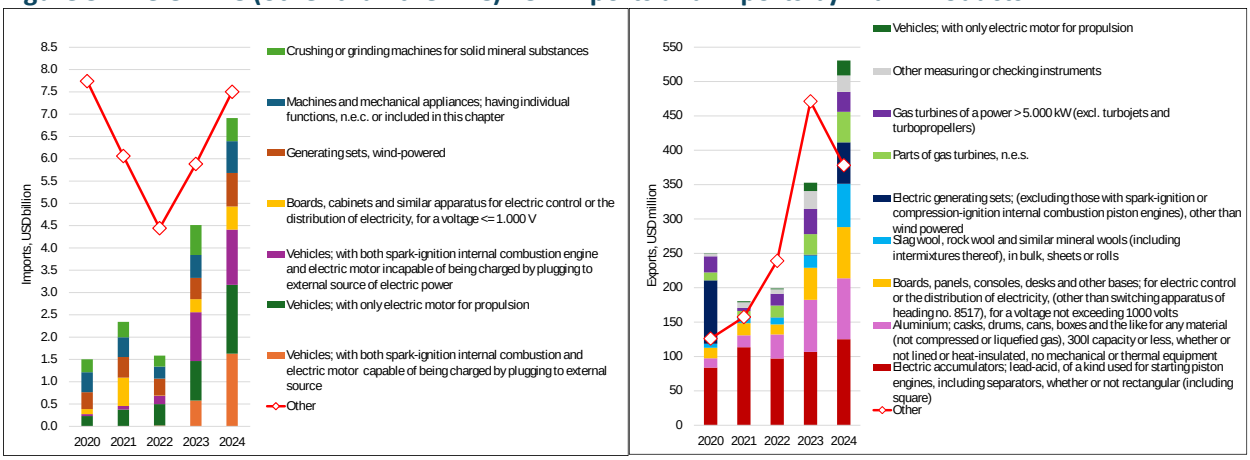
[7] A lithium-ion accumulator is a rechargeable battery that uses lithium ions to store and deliver energy. It is commonly known as a lithium-ion battery

The CAREC region's LCT trade by main products

The product mix of the LCT imports of the CAREC region significantly changed towards EVs from 2023 on. The role of electrical vehicles in LCT imports has become even bigger in the CAREC (other than the PRC) region than globally. The share of "vehicles with both spark-ignition internal combustion and electric motor capable of being charged by plugging to external source" reached 11.3% in 2024, the one of "vehicles with only an electric motor for propulsion" 10.7%, and the one of "vehicles; with both spark-ignition internal combustion engine and electric motor for propulsion, incapable of being charged by plugging to external source" 8.6% (Figure 5, left-hand-chart). Together they thus accounted for 30.6% of total CAREC LCT imports in 2024. The three electrical vehicle categories together with the other ones mentioned in the chart reached 50% of the CAREC region's (other than the PRC) LCT imports. Other important CAREC LCT imports are products related to the region's new wave of electrification, such as "generating sets, wind-powered"[8].

The CAREC region's LCT exports are mostly related to electricity generation and distribution. Electrical accumulators, equipment and instruments dominate the export value (Figure 5, right-hand-side chart). There is some export of EVs, the amount is still small, however.

Figure 5. The CAREC (other than the PRC) LCT Imports and Exports by Main Products



Source: TradeMap, author's calculations.

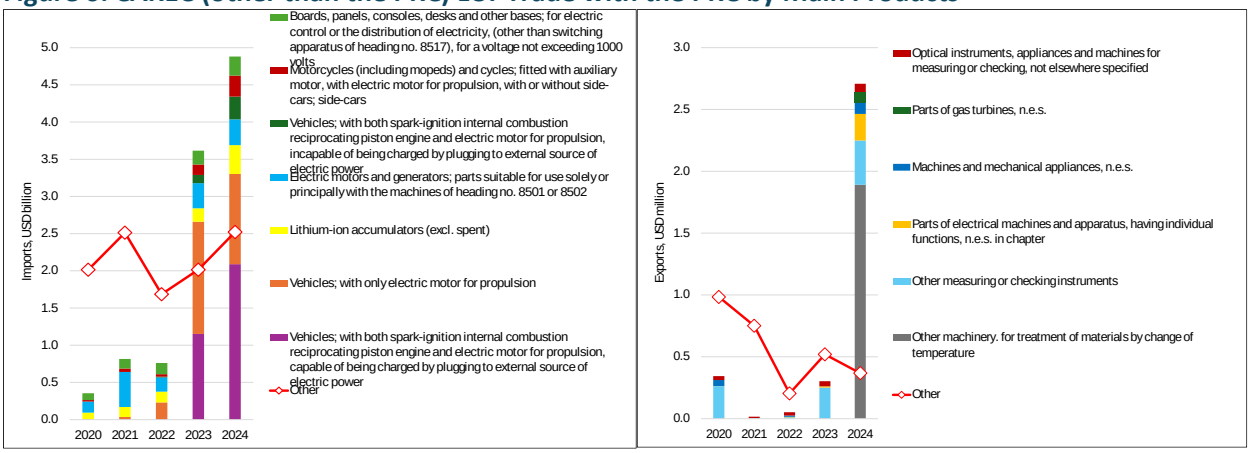
Especially rising EV imports drive the CAREC region's sharply increased LCT imports from the PRC. In 2024, the combined import value of the three EV categories mentioned in Figure 6 (left-hand-side chart) reached USD 3.6 billion and accounted for 49% of all LCT imports from the PRC. Other major LCT imports from the PRC were lithium-ion accumulators (batteries), electric motors and generators, electric motorcycles, and electrical control and distribution components.

The CAREC region's LCT exports to the PRC have remained tiny. There was only a one-off spike in 2024 of the export of "machinery for the treatment of materials by change of temperature", which led to overall CAREC LCT exports to the PRC of USD 3.1 million, up from USD 0.8 million in 2023 (Figure 6, left-hand-side

[8] A "generating set" is a term that refers to a device, including wind turbines, that converts energy (like wind) into electricity. Wind turbines are a type of generating set because they use the wind to rotate blades, which then turn a generator to create power.

chart). The export of “other measuring or checking instruments” also played some role and reached USD 0.3 million in 2024.

Figure 6. CAREC (other than the PRC) LCT Trade with the PRC by Main Products



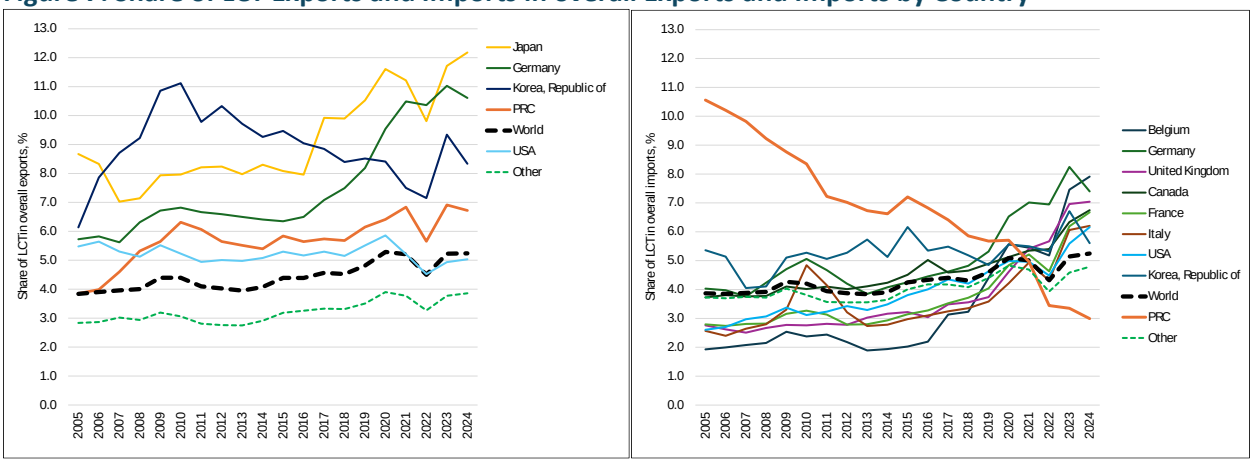
Source: TradeMap, author’s calculations.

The LCT share globally in overall trade

The imminent shift towards low-carbon technologies is driving up the share of LCT products in overall trade. While global overall trade increased by about 130% between 2005 and 2024 at current USD prices, LCT trade was 215% higher. The share of LCT in overall exports rose from 3.9% in 2005 to 5.2% in 2024 as a result (Figure 7).

All the major LCT exporting countries mentioned in Figure 1, except for the USA, had a higher LCT share in their exports in 2024 than in 2005. At 12.2% Japan had the highest ratio in 2024, up from 8.7% in 2005 (Figure 7, left-hand-chart). However, this was against the background of a relatively moderate growth of 19% at current USD prices in overall exports though between 2005 and 2024, a decrease by 26% adjusted for US consumer price inflation of 60% over the same period. Germany’s LCT share in overall exports was at 10.6% the second highest in 2024, up from 5.7%, against the background of overall export growth of 72% in current USD prices. The Republic of Korea came in at 8.3% third in 2024 after some volatility, up from 6.1%, notwithstanding a (above the global) overall export growth of 140%. The PRC was fourth at a ratio of 6.7%, up from 3.9%, with overall export growth of 369%. By contrast, the ratio of the USA turned out slightly below the global reading in 2024 as overall US exports grew by 129%, roughly in line with global export growth. At 5.0% the USA had a lower ratio in 2024 than the 5.5% in 2005. The LCT share of the combined “other” countries remained more than a percentage point below the global average but achieved 3.9% a significantly higher rate in 2024 than the 2.8% in 2005. Interestingly there was a ditch in the LCT trade shares in several countries and overall globally in 2022, caused by the post-Covid recovery in overall trade and at the same time relatively low trade in LCT other than cars.

Figure 7. Share of LCT Exports and Imports in overall Exports and Imports by Country



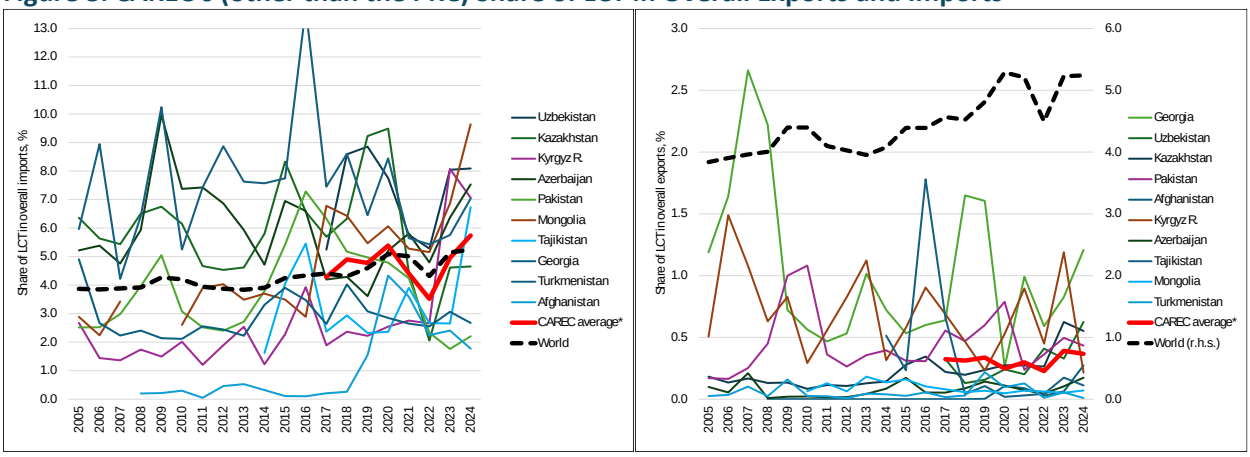
Source: TradeMap, author's calculations.

All the major LCT importers mentioned in Figure 1, except for the PRC, had a higher LCT share in their imports in 2024 than in 2005. With the exception of the Republic of Korea and the PRC, their LCT shares increased between 3.0 (Canada) and 6.0 (Belgium) percentage points (Figure 7, right-hand-chart). The Republic of Korea had a smaller increase, by 0.2 percentage points. Only the PRC, saw a sharp decline from 10.6% in 2005 to 3.0% in 2025, substantially below the global ratio, reflecting the increased domestic LCT production. Most of the countries mentioned in the chart had their ratios' increase against the background of overall import growth below the global reading. Only the Republic of Korea and the PRC had higher growth, the PRC at 192%, substantially higher growth. The LCT share of the combined "other" countries rose from 3.7% in 2005 to 4.8% in 2024, but remained thus slightly below the global figure, while their overall import growth was slightly higher than global overall trade growth.

The CAREC region's LCT share in overall trade

The share of LCT products in overall imports rose on average in the CAREC region roughly in line with the global trend but turned out even a bit higher in 2024 than globally. The share reached 5.7% in 2024, up from 4.3% in 2017, the earliest year where data are available for all CAREC members (Figure 8, left-hand-chart). However, there are significant differences between the CAREC countries. In 2024, six CAREC countries had a higher share than globally, four countries a lower one. Mongolia had at 9.6%, the highest share, up from 2.9% in 2005, followed by Uzbekistan with 8.1%, up from 5.2% in 2017, and Azerbaijan with 7.5%, up from 5.2% in 2005. The lowest ratios were in Afghanistan, Pakistan, and Georgia, with 1.8%, 2.2%, and 2.7%, respectively. However, most countries experienced some volatility in their ratios, most likely related to large specific energy and other projects in the countries.

Figure 8. CAREC's (other than the PRC) Share of LCT in Overall Exports and Imports



*Refers to the simple average of CAREC (excluding the PRC) economies.

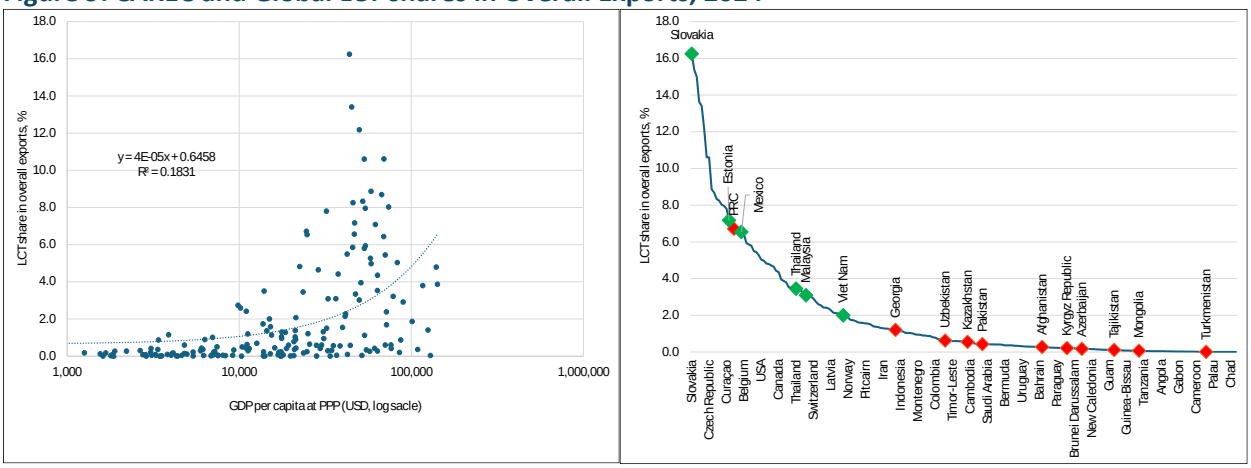
Note: data for Uzbekistan are only available since 2017, for Tajikistan since 2014, for Afghanistan since 2008.

Source: TradeMap, author's calculations.

As mentioned above, the CAREC region (other than the PRC) is not a big LCT exporter currently. Its LCT share in overall exports was at 0.4% on average way below the global figure of 5.2% in 2024, and shares have also not decisively risen (Figure 8, right-hand-chart). Even Georgia, that achieved with 1.2% the highest ratio in 2024, is far off. Kazakhstan and Uzbekistan had 0.6%, Pakistan 0.4%, the ratios for the other CAREC countries were even lower.

Many middle- or lower income economies or not so big countries lack the means or the scale to develop LCT production, and this applies to some extent also to the CAREC region. However, the relation between the LCT export shares and GDP per capita is not very strong. GDP per capita at purchasing power parities (PPP) explained only 18% of the variance in 2024 (Figure 9, left-hand-chart). Slovakia, Estonia and Mexico had ratios of 16.2%, 7.2% and 6.5%, ASEAN countries such as Thailand, Malaysia, and Viet Nam had ratios of 3.5%, 3.1%, and 2.0%, respectively, in 2024 (Figure 9, right-hand-chart). These countries have a GDP per capita at PPP in the range between USD 47,000 (Estonia) and 15,000 (Viet Nam). This compares to USD 39,000 for Kazakhstan, and 11,000 for Uzbekistan. They achieved their high LCT ratios thanks to EVs, mobile phones, data processing machines and other IT equipment exports, strongly related to German (Slovakia), Scandinavian (Estonia), US (Mexico), and Chinese (ASEAN) engagement in the production of these countries. The CAREC region could use its ample resources, improved business climate, and regional trade facilitation to also attract more FDI in these sectors.

Figure 9. CAREC and Global LCT shares in Overall Exports, 2024



Source: TradeMap, author's calculations.

Outlook and Conclusions

Given that much of the CAREC region's LCT trade is related to electricity generation, distribution and control, accelerated electrification will further increase the CAREC region's LCT trade in the future. The CAREC region is undergoing a massive energy transition, heavily investing in hydropower, wind, solar, nuclear, and grid interconnection projects. Kazakhstan has projects underway in the West Kazakhstan region to build wind, solar, and hybrid power plants. In eastern Kazakhstan, there are plans to build five new hydroelectric power plants. The Astana-3 power station, a gas-fired power station, is under development. The country also plans a large nuclear power plant at Lake Balkhash. Uzbekistan is aiming to increase its share of renewables to 25% by 2026, primarily through solar photovoltaic power stations. The country plans to commission solar power stations in various regions, including Navoi, Jizzakh, Samarkand, and Surkhandarya, with a combined installed capacity of 1,100 megawatts. In 2025-2026, solar photovoltaic power stations with a total installed capacity of 1,800 megawatts will be commissioned. Tajikistan continues work on the Rogun hydropower plant (3600 MW) and the Central Asia Power System (CAPS) reconnection. Turkmenistan is also looking at investments in the hydrogen sector and plans to build a hybrid solar-wind power station. The Kambarata-1 hydropower plant (1.86 GW) is a trilateral initiative boosting hydro capacity, water management, and regional electricity trade across the Kyrgyz Republic, Uzbekistan, and Kazakhstan. Azerbaijan and Georgia too invest heavily in new electrification, in projects such as four regional solar plants (500 MW total) in Aghdam, Jabrayil, Fuzuli, and Kalbajar in Azerbaijan, or the power stations in the Samtskhe-Javakheti, Kakheti, Shida Kartli and Imereti regions of Georgia. Pakistan, as well, has highly ambitious electrification plans with projects of many gigawatts such as Bunji (hydro), Bahawalpur (solar), Chashma (nuclear) and many others. These projects and the resulting new wave of electrification will further boost the CAREC region's trade in LCT products, though most likely predominantly on the import side.

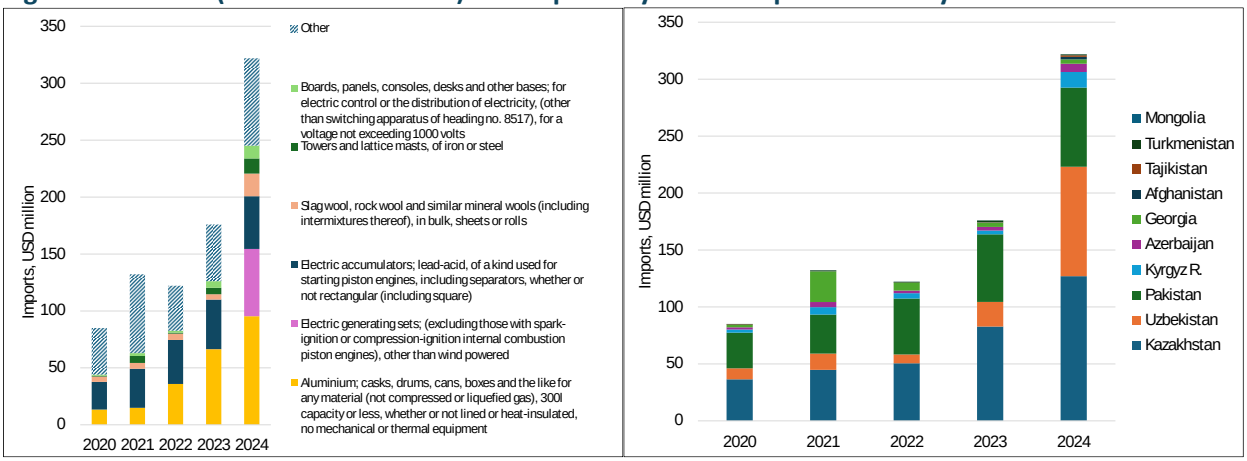
Localized EV production will increase CAREC LCT trade probably mostly due to the import of components, but it also holds the potential to elevate exports, especially intra-CAREC exports. Uzbekistan already has an operational EV production, notably via BYD's Jizzakh plant, and is rapidly scaling up with a target of

500,000 vehicles annually, amongst increasing localization ambitions[9]. In Kazakhstan, two plants for the production of cars and parts will be launched. One of them will produce cars of Chinese brands. It is designed for a production capacity of more than 100 thousand cars. For the spare parts, localization of production is foreseen.[10] BYD also plans a car plant in Karachi, Pakistan, that should be operational by 2026[11]. And a group of Chinese firms has pledged to invest USD 340 million in Pakistan's EV sector to expand manufacturing plants and charging stations[12]. While EV production in all three countries will be mostly for local sales, some EV or parts export might also occur, not least if supported by regional policies. While this is unlikely to raise the LCT share in Uzbekistan's, Kazakhstan's, or Pakistan's overall exports dramatically, it might contribute to at least some increase.

Intra-CAREC (other than the PRC) LCT trade is largely driven by electricity-related equipment and instruments currently. In 2024, out of the total value of intra-CAREC's LCT trade of USD 322 million, electricity generating sets, electric accumulators, boards, panels, and consoles reached a combined value of USD 116.8 million or 36.3% of overall intra-CAREC LCT trade (Figure 10, left-hand-chart). Trade in aluminum containers, another major intra-CAREC LCT trade product, amounted to USD 95 million in 2024, accounting for 29.6% of overall intra-CAREC LCT trade. In the future, EVs could play a stronger role, boosting intra-CAREC trade.

Intensified intra-regional LCT trade would help scale up production and thus enhance cost reduction and competitiveness. In 2024, intra-CAREC (other than the PRC) trade accounted for 2.2% of CAREC LCT imports, up from 0.9% in 2020. The largest intra-CAREC suppliers were Kazakhstan, Uzbekistan, and Pakistan (Figure 10, right-hand-chart). Using their local EV production to further enhance their role in the CAREC region could help them to produce in larger series, allowing them to cut unit costs and become more competitive in exports also beyond the region.

Figure 10. CAREC (other than the PRC) LCT Imports by CAREC Exporters and by Main Products



Source: TradeMap, author's calculations.

[9] https://president.uz/en/lists/view/7730

[10] https://lsm.kz/zarabotayut-dva-zavod-po-proizvodstvu-avto

[11] https://www.reuters.com/business/autos-transportation/chinas-byd-plans-car-plant-karachi-part-pakistan-entry-2024-08-17/

[12] https://www.investmentmonitor.ai/news/china-pledges-340mn-to-pakistans-ev-sector/

To some extent infant industry arguments[13] apply for the CAREC region's LCT production and might constitute a case for public policy support. Given the early development stage of LCT production in the CAREC region (other than the PRC), as evident from the low LCT shares in its overall exports, some specific public support for LCT development and trade might be warranted. This could encompass engaging with foreign investors, providing infrastructure and training for local suppliers, some local content policies, the setting of technical standards, trade facilitation measures related to LCT trade, etc. As a result, the LCT shares in CAREC exports could rise, bringing them closer to the ratios achieved by ASEAN countries.

Limitations of the brief

The brief has limitations regarding its topic, and it has methodological limitations. It analyses only the CAREC region's trade in a small subset of green technologies, and not even the most important ones for the region. Besides, the brief provides little concrete analysis of what public policies are needed to foster the CAREC region's LCT production and trade. This leaves ample space for future, enhanced research.

While the brief's focus is on trade in LCT products, LCT products are only a subset of environmental goods as defined for the IMF. According to the IMF's Climate Change Indicators Dashboard, LCT products are "low carbon technology products produce less pollution than their traditional energy counterparts and will play a vital role in the transition to a low carbon economy", whereas environmental goods "include both goods connected to environmental protection—such as goods related to pollution management and resource management—and adapted goods—which are goods that have been specifically modified to be more 'environmentally friendly 'or cleaner'."[14] While LCT products are seen as coming from "industrial supplies, processed; capital goods; transport equipment; consumer goods", environmental goods are associated with "food and beverages; industrial supplies, primary; industrial supplies, processed; fuels and lubricants; capital goods; transport equipment; consumer goods".

The CAREC region's comparative advantage is likely more in environmental products, enabling LCT than in LCT itself. An example is critical materials, hotly discussed currently globally and in the region. In Kazakhstan, 16 out of 22 critical materials have high geological potential. On top, a significant rare earth elements deposit has been found in Kazakhstan's Karaganda region. Now dubbed "New Kazakhstan," the deposit is estimated to have almost 1 million tons of cerium, lanthanum, neodymium and yttrium, and in deeper layers much more[15]. Uzbekistan is the second most endowed country, and also Tajikistan and the Kyrgyz Republic have high potential for selected critical materials [16].

The CAREC region's comparative advantage is also likely more in electricity itself than in LCT enabling electricity generation, distribution, and control. The CAREC region's electricity exports amounted to USD

[13] These arguments say that an industry in its infancy might need government support/protection to reach a minimal efficient scale of production, allowing it to take off and develop further.
[14] IMF Statistics, Trade in Low Carbon Technology Products, https://climatedata.imf.org/documents/e46085cc97e445bb9c69e7de3bffbbac/explore
[15] https://www.euronews.com/2025/04/10/kazakhstan-discovers-rare-earths-reserve-said-to-be-third-largest-in-the-world
[16] Roman Vakulchuk, Indra Overland, Central Asia is a missing link in analyses of critical materials for the global clean energy transition, https://www.sciencedirect.com/science/article/pii/S2590332221006606

637 million in 2024, only somewhat less than the USD 909 million of all LCT exports together. Of the USD 637 million in electricity exports, USD 538 million or 84% were intra-CAREC (other than the PRC) trade, indicating more opportunities for electricity exports when the region's power plant projects will begin generating and grids will be upgraded and better connected. Similarly, hydrogen might be a future environmental export product.

A much more granular analysis is needed regarding the LCT definition in international trade and on the constant price trade flows. As mentioned above, the HS-6-digit definition is very rough and contains a lot of products that are not clearly LCT. As mentioned above as well, price developments might be highly diverse for different LCT products and require a more detailed analysis.

Looking forward to further progress in the "environmental goods in international trade" analysis and hoping to contribute.

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Annex

List of Harmonized System (HS 2017) Codes Included in the Definition of Low Carbon Technology (LCT) Products for the IMF Climate Change Indicators Dashboard[17]

HS2017	Description
252390	Cement; hydraulic kinds n.e.c. in heading no. 2523
280519	Alkali or alkali-earth metals; other than sodium and calcium
282520	Lithium oxide and hydroxide
282690	Fluorides; fluorosilicates, fluoroaluminates and other complex fluorine salts, n.e.s. in heading no. 2826
282739	Chlorides; other than of ammonium, calcium, magnesium, aluminium, iron, cobalt, nickel and zinc
283691	Carbonates; lithium carbonate
392010	Plastics; plates, sheets, film, foil and strip (not self-adhesive), of polymers of ethylene, non-cellular and not reinforced, laminated, supported or similarly combined with other materials
441873	Wood; assembled flooring panels, of bamboo or with at least the top layer (wear layer) of bamboo
560314	Nonwovens; whether or not impregnated, coated, covered or laminated, of man-made filaments, (weighing more than 150g/m2)
680610	Slag wool, rock wool and similar mineral wools (including intermixtures thereof), in bulk, sheets or rolls
680690	Minerals; mixtures and articles of heat-insulating, sound-insulating or sound-absorbing mineral materials, other than those of heading no. 6811 or 6812 or of chapter 69
700800	Multiple walled insulating units of glass
701931	Glass fibres; non-woven products, mats
701939	Glass fibres; webs, mattresses, boards and similar non-woven products excluding mats and thin sheets
730820	Iron or steel; structures and parts thereof, towers and lattice masts
730900	Reservoirs, tanks, vats and similar containers; for any material (excluding compressed or liquefied gas), of iron or steel, capacity exceeding 300l, whether or not lined or heat insulated
732111	Cooking appliances and plate warmers; for gas fuel or for both gas and other fuels, of iron or steel
732190	Domestic appliances; non-electric, parts thereof, of iron or steel
732490	Iron or steel; sanitary ware and parts thereof, excluding sinks, wash basins and baths
761100	Aluminium; reservoirs, tanks, vats and similar containers, for material (not compressed or liquefied gas), of a capacity over 300l, whether or not lined, not fitted with mechanical/thermal equipment
761290	Aluminium; casks, drums, cans, boxes and the like for any material (not compressed or liquefied gas), 300l capacity or less, whether or not lined or heat-insulated, no mechanical or thermal equipment
840110	Nuclear reactors
840120	Machinery and apparatus; for isotopic separation, and parts thereof

[17] https://climatedata.imf.org/documents/db7225ef9451443cb6907e880e43cd71/about

840140 Nuclear reactors; parts thereof
840219 Boilers; vapour generating boilers, including hybrid boilers n.e.c. in heading no. 8402
840290 Boilers; parts of steam or other vapour generating boilers
840410 Boilers; auxiliary plant, for use with boilers of heading no. 8402 or 8403 (e.g. economisers, super-heaters, soot removers, gas recoverers)
840420 Boilers; condensers, for steam or other vapour power units
840490 Boilers; parts of auxiliary plant, for use with boilers of heading no. 8402 and 8403 and parts of condensers for steam or other vapour power units
840510 Generators; producer gas, water gas, acetylene gas and similar water process gas generators, with or without their purifiers
840681 Turbines; steam and other vapour turbines, (for other than marine propulsion), of an output exceeding 40MW
840690 Turbines; parts of steam and other vapour turbines
841011 Turbines; hydraulic turbines and water wheels, of a power not exceeding 1000kW
841012 Turbines; hydraulic turbines and water wheels, of a power exceeding 1000kW but not exceeding 10000kW
841013 Turbines; hydraulic turbines and water wheels, of a power exceeding 10000kW
841090 Parts for hydraulic turbines
841181 Turbines; gas-turbines (excluding turbo-jets and turbo-propellers), of a power not exceeding 5000kW
841182 Turbines; gas-turbines (excluding turbo-jets and turbo-propellers), of a power exceeding 5000kW
841199 Turbines; parts of gas turbines (excluding turbo-jets and turbo-propellers)
841290 Engines; parts, for engines and motors of heading no. 8412
841581 Air conditioning machines; containing a motor driven fan, other than window or wall types, incorporating a refrigerating unit and a valve for reversal of the cooling/heat cycle (reversible heat pumps)
841780 Other furnaces, ovens, incinerators, non-electric
841790 Parts of furnaces, non-electric
841861 Heat pumps; other than air conditioning machines of heading no. 8415
841869 Refrigerating or freezing equipment; n.e.c. in heading no. 8418
841919 Other instantaneous or storage water heaters, non-electric
841939 Dryers; for products n.e.c. in heading no. 8419, not used for domestic purposes
841940 Distilling or rectifying plant; not used for domestic purposes
841950 Heat exchange units
841960 Machinery for liquefying air or other gases
841989 Other machinery. for treatment of materials by change of temperature
841990 Parts for heat exchange equipment
842121 Water filtering or purifying machinery and apparatus
842129 Other machinery for purifying liquids
842139 Filtering or purifying machinery and apparatus for gases
842199 Parts for filtering or purifying machinery
847420 Machines; for crushing or grinding earth, stone, ores or other mineral substances
847982 Other machines for mixing/grinding, etc.
847989 Machines and mechanical appliances; having individual functions, n.e.c. or included in this chapter
847990 Machines and mechanical appliances; parts, of those having individual functions

848340 Gears and gearing; (not toothed wheels, chain sprockets and other transmission elements presented separately); ball or roller screws; gear boxes and other speed changers, including torque converters
848360 Clutches and shaft couplings (including universal joints)
850161 Generators; AC generators, (alternators), of an output not exceeding 75kVA
850162 Electric generators; AC generators, (alternators), of an output exceeding 75kVA but not exceeding 375kVA
850163 Electric generators; AC generators, (alternators), of an output exceeding 375kVA but not exceeding 750kVA
850164 Electric generators; AC generators, (alternators), of an output exceeding 750kVA
850231 Electric generating sets; wind-powered, (excluding those with spark-ignition or compression-ignition internal combustion piston engines)
850239 Electric generating sets; (excluding those with spark-ignition or compression-ignition internal combustion piston engines), other than wind powered
850300 Electric motors and generators; parts suitable for use solely or principally with the machines of heading no. 8501 or 8502
850490 Electrical transformers, static converters and inductors; parts thereof
850650 Cells and batteries; primary, lithium
850680 Cells and batteries; primary, (other than manganese dioxide, mercuric oxide, silver oxide, lithium or air-zinc)
850710 Electric accumulators; lead-acid, of a kind used for starting piston engines, including separators, whether or not rectangular (including square)
850720 Electric accumulators; lead-acid, (other than for starting piston engines), including separators, whether or not rectangular (including square)
850730 Electric accumulators; nickel-cadmium, including separators, whether or not rectangular (including square)
850740 Electric accumulators; nickel-iron, including separators, whether or not rectangular (including square)
850750 Electric accumulators; nickel-metal hydride, including separators, whether or not rectangular (including square)
850760 Electric accumulators; lithium-ion, including separators, whether or not rectangular (including square)
850780 Electric accumulators; other than lead-acid, nickel-cadmium, nickel-iron, nickel-metal hydride and lithium-ion, including separators, whether or not rectangular (including square)
850790 Electric accumulators; parts n.e.c. in heading no. 8507
851410 Industrial or laboratory electric resistance furnaces
851420 Industrial or laboratory induction or dielectric furnaces
851430 Other industrial or laboratory electric furnaces and ovens
851490 Parts, industrial or laboratory electric furnaces
853120 Signalling apparatus; electric, sound or visual, indicator panels incorporating liquid crystal devices (LCD) or light-emitting diodes (LED), excluding those of heading no. 8512 or 8530
853224 Electrical capacitors; fixed, ceramic dielectric, multilayer
853710 Boards, panels, consoles, desks and other bases; for electric control or the distribution of electricity, (other than switching apparatus of heading no. 8517), for a voltage not exceeding 1000 volts
853931 Fluorescent lamps, hot cathode
853950 Lamps; light-emitting diode (LED) lamps
854140 Photosensitive semiconductor devices, including solar cells

854390 Electrical machines and apparatus; parts of the electrical goods of heading no. 8543
860120 Rail locomotives; powered by electric accumulators
870220 Vehicles; public transport type (carries 10 or more persons, including driver), with both compression-ignition internal combustion piston engine (diesel or semi-diesel) and electric motor for propulsion, new or used
870230 Vehicles; public transport type (carries 10 or more persons, including driver), with both spark-ignition internal combustion reciprocating piston engine (diesel or semi-diesel) and electric motor for propulsion, new or used
870240 Vehicles; public transport type (carries 10 or more persons, including driver), with only electric motor for propulsion, new or used
870340 Vehicles; with both spark-ignition internal combustion reciprocating piston engine and electric motor for propulsion, incapable of being charged by plugging to external source of electric power
870350 Vehicles; with both compression-ignition internal combustion piston engine (diesel or semi-diesel) and electric motor for propulsion, incapable of being charged by plugging to external source of electric power
870360 Vehicles; with both spark-ignition internal combustion reciprocating piston engine and electric motor for propulsion, capable of being charged by plugging to external source of electric power
870370 Vehicles; with both compression-ignition internal combustion piston engine (diesel or semi-diesel) and electric motor for propulsion, capable of being charged by plugging to external source of electric power
870380 Vehicles; with only electric motor for propulsion
871160 Motorcycles (including mopeds) and cycles; fitted with auxiliary motor, with electric motor for propulsion, with or without side-cars; side-cars
900190 Optical elements; lenses n.e.c. in heading no. 9001, prisms, mirrors and other optical elements, unmounted, of any material (excluding elements of glass not optically worked)
900290 Optical elements; n.e.c. in heading no. 9002 (e.g. prisms and mirrors), mounted, being parts or fittings for instruments or apparatus, of any material (excluding elements of glass not optically worked)
901380 Optical devices, appliances and instruments; n.e.c. in heading no. 9013 (including liquid crystal devices)
901390 Optical appliances and instruments; parts and accessories for articles of heading no. 9013
901580 Surveying equipment; articles n.e.c. in heading no. 9015, including hydrographic, oceanographic, hydrological, meteorological or geophysical instruments and appliances (excluding compasses)
902610 Instruments for measuring the flow or level of liquids
902620 Instruments for measuring or checking pressure
902680 Other instruments for measuring liquids or gases
902690 Parts of instruments for measuring, checking liquids or gases
902710 Instruments for analysing gas or smoke
902720 Chromatographs, etc.
902730 Spectrometers, etc.
902750 Other instruments using optical radiation
902780 Other instruments for physical or chemical analysis
902790 Parts for instruments, incl. microtomes
903149 Other optical instruments
903180 Other measuring or checking instruments

903190	Instruments, appliances and machines; parts and accessories for those measuring or checking devices of heading no. 9031
903210	Thermostats
903220	Manostats
903289	Other automatic regulating, controlling instruments
903290	Regulating or controlling instruments and apparatus; automatic, parts and accessories
903300	Machines and appliances, instruments or apparatus of chapter 90; parts and accessories n.e.c. in chapter 90