GLOBAL NONWOVEN MARKETS REPORT

A COMPREHENSIVE SURVEY AND OUTLOOK

2020-2025

INDA® Association of the Nonwoven Fabrics Industry
Advancing Engineered Material Solutions

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Global Nonwoven Markets Report

A Comprehensive Survey and Outlook

2020 – 2025

Macro-Drivers

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FOREWORD

INDA and EDANA are pleased to publish this **seventh edition** of the Global Nonwoven Market Report, formerly the Worldwide Outlook for the Nonwovens Industry. It is amazing to believe this multi-billion dollar industry had its modern start only fifty years ago. Until the beginning of the 21st century, the nonwovens industry was primarily based in Europe, North America, and Japan. It is in those three regions that modern nonwoven technologies were conceived and developed. Now, nonwovens are produced on thousands of lines around the world. The nonwovens industry is now truly global. The worldwide nonwovens industry's **prospects continue to be favorable**, and it remains a **rewarding and dynamic industry** in which to be involved.

By fulfilling fundamental and more sophisticated needs, nonwoven-based products bring value and benefits to society in a variety of applications from personal to health care, filtration to transportation, and construction to apparel.

This report presents detailed production data by region for the global nonwovens industry for 2010, 2015 and 2020, and a forecast for 2025. Specifically, the goals of the report were to

- provide economic and demographic trends, as they are significant drivers of demand within the nonwovens industry;
- explain industry trends within regions, processes, end uses, raw materials, and trade flows;
- present industry production for region by process and end use markets;
- provide an overall picture of global nonwoven roll goods trade; and
- define and clarify production processes and end use market segmentation to provide greater clarity in the industry.

EDANA and INDA are allies in a strategic partnership to create an environment beneficial to the sustainable and profitable growth of the nonwovens industry. It is also our role to **provide credible statistics to our members and the overall industry**. To that end, we are publishing this report to provide a benchmark of the industry's progress through the years. This information is intended to assist those in the nonwovens industry in making better business decisions.

It is our intention to continue to **improve the quality** of data and industry information. Your comments are what drive change, and we would appreciate your suggestions for information you would like included in future reports of the nonwoven industry. Please feel free to contact either of the report authors (Brad Kalil, INDA and Jacques Prigneaux, EDANA) regarding any aspect of this report.

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EXECUTIVE SUMMARY

INDA and EDANA are pleased to publish this **seventh edition** of the Global Nonwoven Market Report, formerly the Worldwide Outlook for the Nonwovens Industry. Until the beginning of the 21st century, the nonwovens industry was primarily based in Europe, North America, and Japan. It is in those three regions that modern nonwoven technologies were conceived and developed. Now, nonwovens are produced on thousands of lines around the world. The nonwovens industry is now truly global. The worldwide nonwovens industry's **prospects continue to be favorable**, and it remains a **rewarding and dynamic industry** in which to be involved.

Macro Drivers

The strength of the economy and demographic trends are **the significant drivers of demand** within the nonwovens industry. Consumer discretionary spending and business investment—both correlated to the strength of the economy—drive demand in nearly every nonwoven end use category, while certain demographic trends—such as births and aging—drive demand in the remaining end use categories. The basic building blocks of nonwovens demand are thus based upon the global economic and population forecasts.

Through the forecast period (2021–2025), **three items are of the greatest significance in regard to the economic forecast**:

- The evolution of the pandemic;
- The pace of vaccination; and
- Monetary and fiscal policy responses to the pandemic.

Overall global growth is forecast to expand 4.0% annually. However, this will be marked by a significant uptick in 2021 (5.8%) as countries rebound from the COVID-19 pandemic induced recession in 2020 (–3.3%). Beyond 2022, the global economy will then moderate to the long-term potential rate in the three percent range through later years of the forecast period.

In the first two years the world economy will experience an exceptionally strong but highly uneven recovery. Growth will be concentrated in the advanced economies, with most emerging market and developing economies (EMDEs) lagging behind. The majority (90%) of advanced economies are expected to regain their pre-pandemic per capita income levels by 2022, only about one-third of EMDEs are expected to do so.

Meanwhile, **three demographic trends** play a role through the forecast period:

- global population growth is slowing, as is the absolute number of babies born;
- the increasing total population of the elderly; and
- the rising level of GDP per capita globally, after falling as a result of the pandemic.

The relationship between nonwovens and population impacts more than just the absorbent hygiene market; as the elderly age, the medical/surgical market grows, and as families start, the home and office furnishings market increases, as does the building construction market.

Currently, the world population continues to grow, albeit more slowly than in the recent past. The global population growth rate peaked in 1962 and has been declining ever since, as world population growth has halved. In the 1980s global population grew 1.8% annually and has dropped to 1.2% annually in the 2010s.

The world **population is forecast to significantly slow through the forecast period** (2021–2025) expanding only 0.99% percent a year, adding 77.3 million people annually. While this may not seem significant, through the five-year forecast period an additional 386 million people are added, 16 million less than the previous five-year period. This compares to only a decline of 1.4 million people in the previous five-year period.

Nonwovens Supply

The worldwide production of nonwoven roll goods reached 17.9 million metric tonnes in 2020, equivalent to US$64.4 billion. The tonnage volume was equal to about 499 billion square meters in 2020. INDA and EDANA **forecast that worldwide nonwovens production will continue to grow**, and expect that in the period from 2020 through 2025, the industry will expand at an annual average rate of 2.7% and reach a volume of at least 20.4 million metric tonnes.

This average annual growth rate (2.7%) for the forecast period could be seen as very conservative compared to the evolution recorded over the past decade, but this forecast—constructed on the starting point of December 31, 2020—is based on the very production high level reached in 2020. The significant growth rates in nonwoven materials used during the COVID-19 pandemic (absorbent hygiene, protective medical apparel, face masks/respirators, and wipes) more than offset, in terms of volumes, the loss in important sectors for this industry—like those materials used in the production of vehicles, building construction, geotextiles, and home & office furnishings.

Indeed, the global production increased by 12.7% in 2020 compared to 2019, far over the annual average rate recorded between 2010 and 2019, which was 5.5%. To reach the forecasted tonnage for 2025, the total production will grow on average by 4.3% from the 2019 level, about half a point lower than the industry was expected to grow over the period 2018–2023 in the previous edition of this report called Worldwide Outlook Nonwovens. Therefore, if we use 2019 as reference, global nonwovens production volume will continue to outpace GDP in the long-term.

Asia is by far the dominant nonwoven producing region, accounting for (49%) of the world's production in 2020, up from a third (35%) in 2010. China accounts for a significant proportion (81%) of the Asia volume and remains the most important nonwovens producer globally with production volume in 2020 estimated at 7.063 million tonnes and equivalent to more than a third (40%) of global nonwovens production in 2020.

The production of nonwovens in **North America** is forecast to 2.4% annually, slower than North American real GDP (3.2% annually), given the COVID-19 induced boost of nonwoven production in 2020 (3.5%) and the economic rebound of 2021 GDP. **Greater Europe**—which includes Turkey, a significant producer of nonwovens—will also experience a lower nonwoven growth of around 2.5% until 2025, relative to its 2020 level. One can consider this expected rate as conservative and very low compared to the evolution recorded in 2010–2020. Nonetheless, 2020 was not in line with long-term trend in Europe and these 2025 forecasts follows the expected long-term development of the local demand and the trend observed in the export market. The **South American** region's nonwovens output, after experiencing 4.6% annual growth over the last decade, is forecast to grow 3.9% annually through the forecast period. In **Middle Eastern & North African** (MENA) after experiencing an average growth of 6.5% over the last decade, will keep rising by 8.4% annually through the forecast period.

The spunlaid and drylaid processes accounted for the majority of nonwovens production in 2020, 88% of the tonnage. Global **drylaid** nonwovens output, including all bonding processes, have shown considerable growth over the past decade from 2010–2020, rising 6.0% per year. Drylaid production is forecast to rise to about 8.4 million tonnes in 2025, a 3.4% annual increase. The overall production of **spunlaid**—all polymer-based nonwovens—grew at an average rate of 7.7% annually from 2010 through 2020. According to the already announced new capacities and the development of demand to be fulfilled, global spunlaid over the next five years, an average annual growth rate of

1.8% is forecast worldwide. Again, this forecast growth rate for the next five years can be seen as very conservative, however, it is based on a very high level of production in 2020. Lon-term trends calculation based on 2019 as a starting point, provides similar annual average growth rates in 2010–2019 and in 2019–2025, respectively 5.6% and 5.8% annual growth rates.

On a global basis, **wetlaid** nonwovens grew from 1.176 million tonnes in 2010 to 1.570 million tonnes at the end of 2020. This represents an average annual growth rate of 3.8% in tonnage. By 2025, recent investments in this technology will reach higher utilization rates and new investments are also expected in different regions, raising the output close to 1.9 million tonnes at the end of the forecast period, a 3.8% annual growth rate. The production of **airlaid short-fiber** grew at an average annual rate of 1.3% from 2010 through 2020. The technology is expected to experience a lower growth rate of 3.6% per year with volume reaching about 724,000 tonnes by the end of 2025.

Nonwovens Demand

Production growth through the historical period (2010–2020) varied across the individual end use categories as each has its own unique demand drivers, notably being impacted by COVID-19 in 2020. While some end uses are more impacted by population growth and rising incomes (typically the single-use end uses), others are impacted by the health of the economy and taking share from other competing materials (typically the durables end uses). Further, each may be at a different development stage and/or penetration rate within a global region.

Absorbent hygiene is by far the single largest end-use category accounting for a nearly a quarter (20%) of the global production in 2020; this is down from a quarter (27%) in 2010. Due to the need for protective medical apparel, the nonwoven production for the medical end use skyrocketed from representing just six percent (5.5%) of the production in 2010 to 14% of the production in 2020, moving it to third, just behind the other category.

At the end 2025, the absorbent hygiene is still forecast to be the largest market, accounting for 21% of the global production. Meanwhile, as the need to keep the surfaces we touch clean, protect the air we breathe and the liquids we drink clean, the production shares of wipes and filtration continue to rise. Further, through the forecast period the medical end use returns closer to its historical share as some of the demand for protective medical apparel abates, but also as the vehicle and housing construction markets ramp return.

In the previous ten years (2010–2020), average annual growth rates across the end uses ranged from 16.4% (medical) to 1.3% (home and office furnishings). Through the forecast period geosynthetic applications are expected to experience the strongest growth (7.4% annually), while the slowest is forecast to be the medical category (–11.9%). Through the forecast period, overall nonwovens production is forecast to expand 2.7% annual.

Within the durables end uses—as seen in some regions with a slowing economy—end use can vary greatly, as the building construction and transportation markets did not react in the same way during the historical period. This is a result, in general, of some of the durable end uses—notably transportation—taking share from other materials, due to the flexibility of an engineered fabric that through innovation can be adapted to meet the needs of materials for today and into the future. Nonwovens provide options for weight and cost savings due to their versatility, functionality and recyclability.

Trade Flows

The year 2020 will remain in history as the year of the beginning of the reshaping of globalization. The world economy recorded its deepest and most synchronized collapse. Factories shut down, countries closed, goods and people stopped crossing borders and the world trade shuddered. Firms found long supply chains to be unwieldy and risky.

These did not apply to the nonwovens industry as the international trade of roll goods accelerated further in 2020. Global demand for absorbent hygiene, protective medical apparel and face mask/respirator nonwovens exploded. Production increased with many lines approaching full, in not full, utilization rates, and new lines starting. Despite tariffs, the limited availability of containers and other constraints, global trade flows of roll goods has never been as high as in 2020. For many countries, imports of nonwovens materials were crucial to fight against the pandemic.

In ten years, the big picture of the worldwide trade of nonwovens has changed quite significantly. The evolution of nonwoven exports in both volumes and value has been impressive. In 2020—taking into account trade flows between the 27 countries of the European Union—more than 4.4 million tonnes of nonwovens, valued at around US$16.5 billion were exchanged worldwide. Calculation on the same basis for 2010 showed an approximate 2.6 million tonnes valued at US$11.4 billion. This evolution is by definition linked to the expansion of production capacities worldwide, but also to the unusual consumers demand we experienced in 2020.

Regional Summaries

North America

The North America region is comprised of Canada, Mexico and the United States of America and represented 19.2% of the world's economies (GDP based on purchasing power parity) in 2020. The economic growth of North America is expected to average 3.2% annually through the forecast period (2021–2025). This compares to an annual growth of 1.3% in the last five years (2015–2020) and 1.8% in the last ten years (2010–2020).

North American population growth has been gradually slowing over the last 29 years and is forecast to continue slowing through the forecast period. Millennials will begin starting families in the United States, causing a rise in births, while Mexico will experience a decrease in birth rates with the growing economic and social development in the country. Overall, the population of North America is expected to average 0.68% annual growth through the forecast period, adding an additional 17.1 million people. This compares to an annual growth of 0.74% in the previous five years when a total of 18.0 million people were added, and a rate of 0.81% in the previous ten years.

The nonwovens output of North America, after experiencing 2.9% annual growth over the last decade, will keep growing by 2.4% per annum during the forecast period. Given the larger base, this represents a slightly smaller average annual tonnage growth in the forecast period (121,800 tonnes), compared to the average tonnage added in the previous five years (179,100 tonnes/year).

One of the points of reference for the **continued strong forecast growth rate** is that the annual average production growth increased significantly in the last five years (2015-2020) compared to the previous five-year period (2010-2015), as the impact of lightweighting most likely slowed—in addition to capacity rationalization—in the spunlaid processes, and the growth in housing construction and filter media improved the wetlaid process production. From 2005 to 2010, production expanded at a 5.7% annual rate, while due to a few years of declining production impacted by the slow recovery from the Great Recession, production expanded at only 1.0% annually from 2010 to 2015.

North American production of **spunlaid**—all polymer-based nonwovens—grew at an average annual rate of 2.7% from 2010 to 2020 and is forecast to expand 1.8% through the forecast period. Production of **drylaid nonwovens**—including all bonding processes—in

North America rose 3.8% per year through the historical period and is forecast to rise 3.0% annually from 2021 through 2025.

The three largest end use markets in North America were transportation, absorbent hygiene, and filtration, which, respectively, grew 15.2%, –3.1%, and 5.9% annually from 2010 to 2020. Through the outlook period, they are forecast to grow annually 2.5%, 2.1%, and 4.4%, respectively. By 2025, those three will still remain the largest end use markets in North America.

The United States nonwovens market is influenced by both inter-region (exports mainly to the other North and South American countries) and intra-region ((imports mainly from overseas countries) trade of nonwoven rolled goods. Over time, exports from the United States have exceeded imports, but as of 2012 the U.S. net trade balance has been decreasing to be negative since 2016. In 2020, the pandemic highly impacted the need for nonwovens materials, and overseas imports took a major and erratic jump, increasing 66.9% compared to the 2019 level. In 2020, half (55%) of U.S. imports came from Asian countries. China is by far the largest single-supplier to the United States, representing a third (36%) of the U.S.'s total imports.

Greater Europe

The Greater Europe region—includes all the countries of Western, Central and Eastern Europe, in addition to Turkey and the Commonwealth of Independent States—accounted for a quarter (25%) of the global economic output in 2020. Overall, Greater Europe's economic growth is expected to average 3.0% annually through the forecast period (2021–2025). This compares to an annual growth of 0.8% in the preceding five years and annual growth of 1.2% in the preceding ten.

As with its economic development, Greater Europe is very heterogeneous in regards to its population growth, birth rates and life expectancy with considerable divergence within the region. As a whole, though, greater European population growth has been moderate over the last 10 years expanding 0.4% annually; however, there was a significant range of growth rates, with five countries (Kyrgyz Republic, Luxembourg, Malta, Tajikistan, and Uzbekistan) all having average annual growth rates over 1.5% and 18 countries contracting, including Greece, Poland, and Portugal. The picture is somewhat similar in the forecast period with growth rates ranging from 2.1% (Kyrgyz Republic) to –1.8% (Moldova). Within the region the annual growth rates slow in Western Europe and the Commonwealth of Independent States and increase in Central Europe.

Greater Europe's production of nonwovens grew in the historical period, rising from 2.1 million tonnes in 2010 to over 3.1 million tonnes in 2020. Greater Europe will experience a lower nonwoven growth of around 2.5% until 2023. This represents an average annual growth rate of 4.0%. Production in Greater Europe will experience a lower nonwoven growth of around 2.5% through to 2025, relative to its 2020 level. The production of nonwovens in Greater Europe jumped by 7.2% in 2020 compared to the previous year, mainly due to the urgent need for medical apparel and face mask/respirator material and despite depressed vehicle and building construction markets.

Greater European production of **drylaid nonwovens** grew at an average annual rate of 4.1% during the historical period and is forecast to expand 2.7% annually 2021 through 2025. Production of **spunlaid** in the region rose 4.6% per year from 2010 through 2020 and is forecast to rise 1.7% annually through the forecast.

The three largest Greater Europe end use markets in 2020 were absorbent hygiene, wipes, and home & office furnishings, which, respectively, grew 4.1%, 7.1%, and 1.0% annually from 2010 to 2020. Through the outlook period they are forecast to grow annually 1.6%, 2.9%, and 2.8%, respectively, remaining the three largest.

In 2020, EU27 exports of nonwovens to the rest of the world increased by 6% in volume compared to 2019, but imports increased faster again by 11%, meaning the EU27 trade balance actually decreased by nearly 5% in one year. Over the last decade, EU27 exports grew by 27% and imports by 142%. The trade between member countries within the European Union, the so called intra-trade, has also been constantly growing over the last decade. While 775,740 tonnes of nonwovens (valued at 2,719 million euros) were traded between EU27 countries in 2010, it amounted to 1,088,500 tonnes (3,967 million euros) ten years later. Compared to the previous year, the volumes exchanged increased by 4%, but the euro value decreased by 2%.

Asia

Asia—for the purpose of this report—is defined as a 37-country region including Asia, South East Asia and the Pacific Islands and is the largest economic region of the five classified in the report, accounting for over a third (41%) of the world's economic output. Through the forecast period Asia will experience the strongest growth of the regions, averaging 5.5% annually. Asia escaped the worst of the COVID-19 pandemic in 2020, but the virus has returned with a vengeance in 2021. The pace of recovery in the global tourism sector will influence the timeline for the recovery of many Asian economies. It is not expected that global tourist arrivals or expenditures will return to pre-pandemic levels until 2023.

The Asia region includes five (China, India, Indonesia, Pakistan, and Bangladesh) of the ten largest countries in the world, accounting for more just less than half (45%) of the world's population. The population growth rate for the advanced economies in Asia (Japan, Korea, Taiwan, Hong Kong, and Singapore) was slightly positive through the historical period, 0.09%, and is forecast to decline 0.18% annually through the forecast period. The rest of Asia, though, is forecast to continue its strong population growth; however, the forecast growth rate is slower than that of the historical growth rate. The total Asian growth rate expanded in the previous ten years at a 0.89% annual rate; excluding the advanced economies, the growth would have been 0.94% annually. In the forecast period, Asia's population is forecast to expand 0.69% annually, adding an additional 143.5 million through the forecast period, compared to 168.5 million added in the previous five year period.

Asia is by far the dominant nonwoven producing region, accounting for nearly half (49%) of the world's production in 2020, up from a third (35%) in 2010. The overall nonwovens production in Asia **more than doubled in one decade**, from 3.4 million tonnes in 2010 to 8.8 million tonnes in 2020. China accounts for a significant proportion (81%) of the Asia volume and is remains the largest nonwovens producer worldwide with production volume in 2020 estimated at 7.1 million tonnes and equivalent to more than a third (10%) of global nonwovens production in 2020. It is forecast that the country's nonwoven growth will slow to about 2.3% per year (based on the high level of production in 2020) through the coming five-year period to 2023. Nonetheless, it means China will produce 12% more than in 2020 equivalent to 840,000 tonnes. The region's overall growth is predicted to rise 2.4% through the forecast period (2021–2025).

Asian production of **drylaid nonwovens** grew at an average annual rate of 8.3% from 2010 to 2020 and is forecast to expand 3.5% through the forecast period. Production of **spunlaid** in Asia rose 12.0% per year through the historical period and is forecast to rise 1.2% annually from 2021 through 2025. Once again, each of the rated being distorted by the incredibly high production rate for the region in 2020, 23.9% over 2019.

The three largest end use markets, outside of "other" in Asia were medical (which in Asia's reporting included face masks and respirators), absorbent hygiene, and wipes which, respectively, grew 29.6%, 6.2% and 12.1% annually from 2010 to 2020. The significant shift in 2020 to produce "medical" material resulted in growth of 400% over 2019. Through the outlook period (2021–2025), they three are forecast to grow annually –18.3%, 4.9% and 8.0%, respectively. By 2025 it is forecast filtration will move into the top three largest categories replacing medical.

Chinese exports of nonwovens roll goods have continually grown since the beginning of the century. In 2010, only 373,300 tonnes—of which 168,800 of those tonnes remained in Asia—were exported out of China. In 2011, China became the leading global exporter of nonwoven roll goods. In just ten years, China increased its exports by one million tonnes.

In 2010, both in exports and imports, Chinese trade flows were focused on the rest of Asia, which represented 45% of Chinese exports and 49% of imports. A decade later, Asian countries are still their most important trade partners (53.5% of exports and 53.8% of imports). Nevertheless, China has also intensified its trade of nonwovens with the rest of the world in volumes. Outside Asia, the European Union and the United States were important destinations for Chinese material. China exported more to Central and South American countries than to the U.S. in 2020.

Summary

In summary, the outlook for the worldwide nonwovens industry is very encouraging, not only with the positives of relatively strong economic outlook and demographic trends for nonwoven usage, but also with the growth by the inherent nature of nonwovens being material engineered for a specific use. The demand for nonwovens is not only driven by the economy and demographic trends, but as nonwovens can be engineered to meet specific performance attributes for a specific end use, the gaining of share from other materials in existing end uses and the ability to enter entirely new end uses will continue to be catalysts for nonwovens growth.

And lastly—and most importantly—nonwovens are a business that protects and improves people's lives. This has been brought to the forefront recently with the benefits of protective medical apparel, respirators, face masks, and disinfecting wipes, now known by all. The nonwovens industry has responded to the pandemic and will continue to provide materials that keep the surfaces we touch clean, make safe the air we breathe, and provide a barrier to keep our bodies safe.

I. MACRO-DRIVERS

The strength of the economy and demographic trends are **the significant drivers** of demand within the nonwovens industry. Consumer discretionary spending and business investment—both correlated to the strength of the economy—drive demand in nearly every nonwoven end use category, while certain demographic trends—such as births and aging—drive demand in the remaining end use categories. The basic building blocks of nonwovens demand are thus based upon the global economic and population forecasts.

Over the forecast period (2021–2025), three items are of the greatest significance in regard to the economic forecast:

- The evolution of the pandemic;
- The pace of vaccination; and
- Monetary and fiscal policy responses to the pandemic.

Overall global growth is forecast to expand 4.0% annually. However, this will be marked by a significant uptick in 2021 (+5.8%) as countries rebound from the COVID-19 pandemic induced recession in 2020 (–3.3%). Beyond 2022, the global economy will then moderate to the long-term potential rate in the three percent range through later years of the forecast period.

In the first two years the world economy will experience an exceptionally strong but highly uneven recovery. Growth will be concentrated in the advanced economies, with most emerging market and developing economies (EMDEs) lagging behind. The majority (90%) of advanced economies are expected to regain their pre-pandemic per capita income levels by 2022, only about one-third of EMDEs are expected to do so.

Meanwhile, three demographic trends play a role through the forecast period:

- global population growth is slowing, as is the absolute number of babies born;
- the increasing total population of the elderly; and
- the rising level of GDP per capita globally, after falling as a result of the pandemic.

The relationship between nonwovens and population impacts more than just the absorbent hygiene market; as the elderly age, the medical/surgical market grows, and as families start, the home and office furnishings market increases, as does the building construction market.

Currently, the world population continues to grow, albeit more slowly than in the recent past. The global population growth rate peaked in 1962 and has been declining ever since, as world population growth has halved. In the 1980s global population grew 1.8% annually and has dropped to 1.2% annually in the 2010s.

In the last ten years (2011-2020) the global growth rate was 1.13%, adding an average 80.5 million people annually. In the last five years, population growth has further slowed, growing at annual rate of 1.08% in the last five years, when 80.4 million people were added annually, adding an additional 400 million people.

The world population is forecast to significantly slow through the forecast period (2021–2025) expanding only 0.99% percent a year, adding 77.3 million people annually. While this may not seem significant, through the five-year forecast period an additional 386 million people are added, 16 million less than the previous five-year period. This compares to only a decline of 1.4 million people in the previous five-year period (2016–2020).

Economic Growth

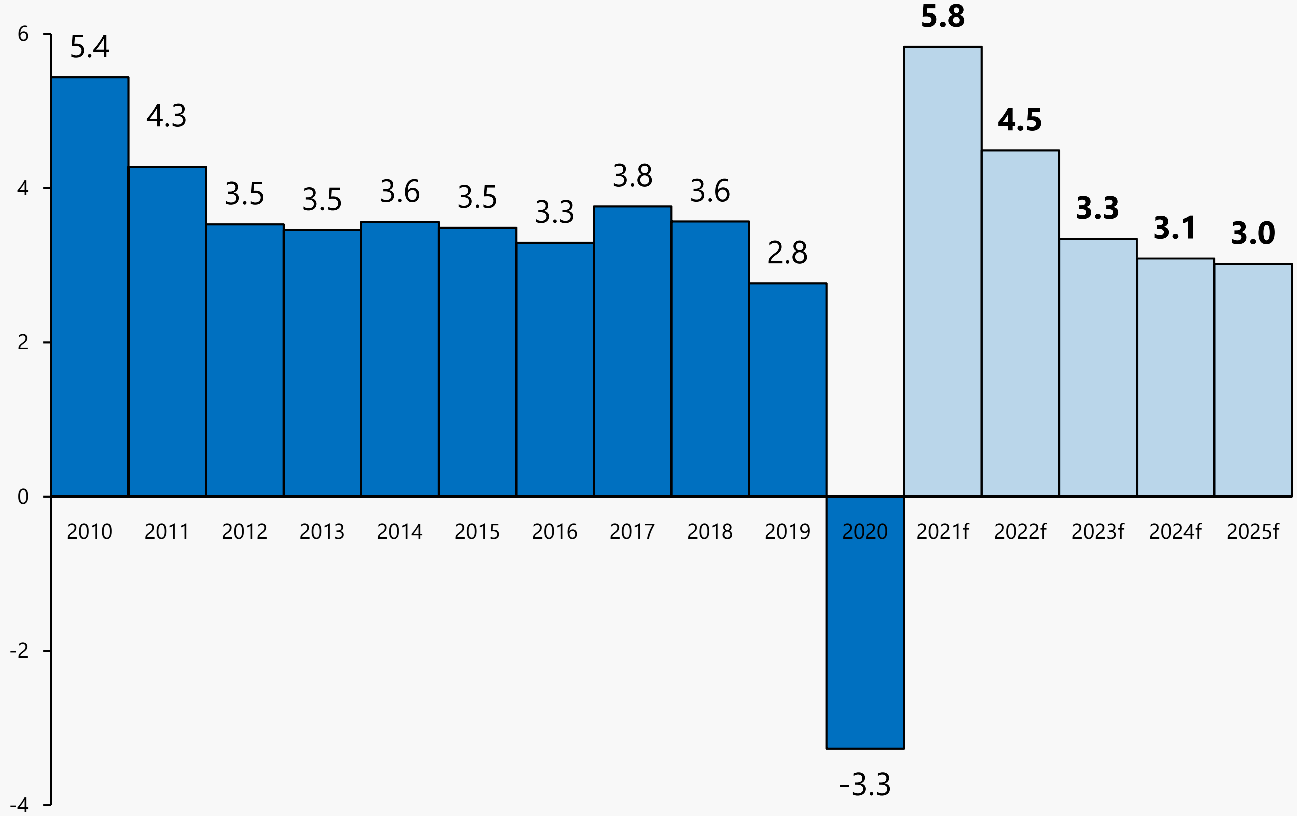
The COVID-19 pandemic sent the global economy into deep recession in 2020; global GDP contracted by 3.3%, the worst outturn since the 1930s. The ongoing pandemic continues to shape the path for global economic activity, with outbreaks continuing to weigh on growth in many countries. Headline growth rates will be deceptive this year, given the low base of comparison; economies that contracted the most in 2020 will generally register the fastest growth rate. Overall, it is expected that global GDP will not recover to pre-coronavirus (2019) levels before late 2021. Global forecasts mask disparities between countries and regions; Asia and North America will recover the fastest, with real GDP returning to pre-COVID levels this year, with Europe, Latin America, and the Middle East and Africa waiting until 2022.

Against this backdrop, global output growth is projected to strengthen to 5.8% in 2021 and is envisioned to continue into 2022, with global growth moderating to 4.5%. Still, by 2022, global GDP is expected to remain 1.6% below pre-pandemic projections. Beyond 2022, the global economy will then moderate to the long-term potential rate in the three percent range through the later years of the forecast period from the high growth rates seen in the immediate aftermath of the pandemic recession. The severe contraction induced by the global pandemic may leave a permanent scar on global growth in the long run, but global growth is expected to return to close to, but not higher than, previous projections made before the pandemic. Factors that have for a large part driven global growth in the last two decades, including the greater supply of labor and fast growth in capital stock to worker ratios, are expected to weaken substantially over the next decade. These slowing factors will only be partially offset by a shift towards greater contributions from qualitative growth sources, driven by accelerating digital transformation and productivity improvements, as well as additional long-term investments in physical and social infrastructure in large economies including the United States. (Figure I-1).

The evolution of the pandemic and the pace of vaccination will be the most crucial factor driving the outlook. The baseline assumes that progress at vaccination will help to effectively contain COVID-19 in advanced economies by the end of 2021, with most of major developing countries also making substantial progress at reducing transmission.

Through the forecast period (2021–2025), global real GDP growth of 4.0% is forecast, compared to 2.3% the previous five-year period (2015–2020) and 3.1% the previous ten (2010–2020) (Figure I-1).

Figure I-1
Global Annual Growth of Real GDP, 2010-2025
Percent Change From Preceding Period



Source: IMF and INDA/EDANA Estimates, 2021

The last issue of this report, the <u>Worldwide Outlook for the Nonwovens Industry, 2018–2023</u>, published in August of 2019, forecast global growth of 3.3% in the forecast period of 2018–2023.

Uncertainty surrounding the global baseline remains high, primarily related to the prospects of emerging market and developing economies. Although growth could turn out to be stronger than projected, downside risks dominate in the near term.

On the upside, better global cooperation on vaccines could help prevent renewed waves of infection and the emergence of new variants, end the health crisis sooner than assumed, and allow for faster normalization of activity. Moreover, a sooner-thananticipated end to the health crisis could lead to a faster-than-expected release of excess savings by households, higher confidence, and more front-loaded investment spending by firms.

On the downside, growth would be weaker than projected if logistical hurdles in procuring and distributing vaccines in emerging market and developing economies lead to an even slower pace of vaccination than assumed. Such delays would allow new variants to spread, with possibly higher risks of breakthrough infections among vaccinated populations. Moreover, households' excess savings may be released more gradually if they remain worried about employment prospects and income security, weighing on aggregate spending.

North America

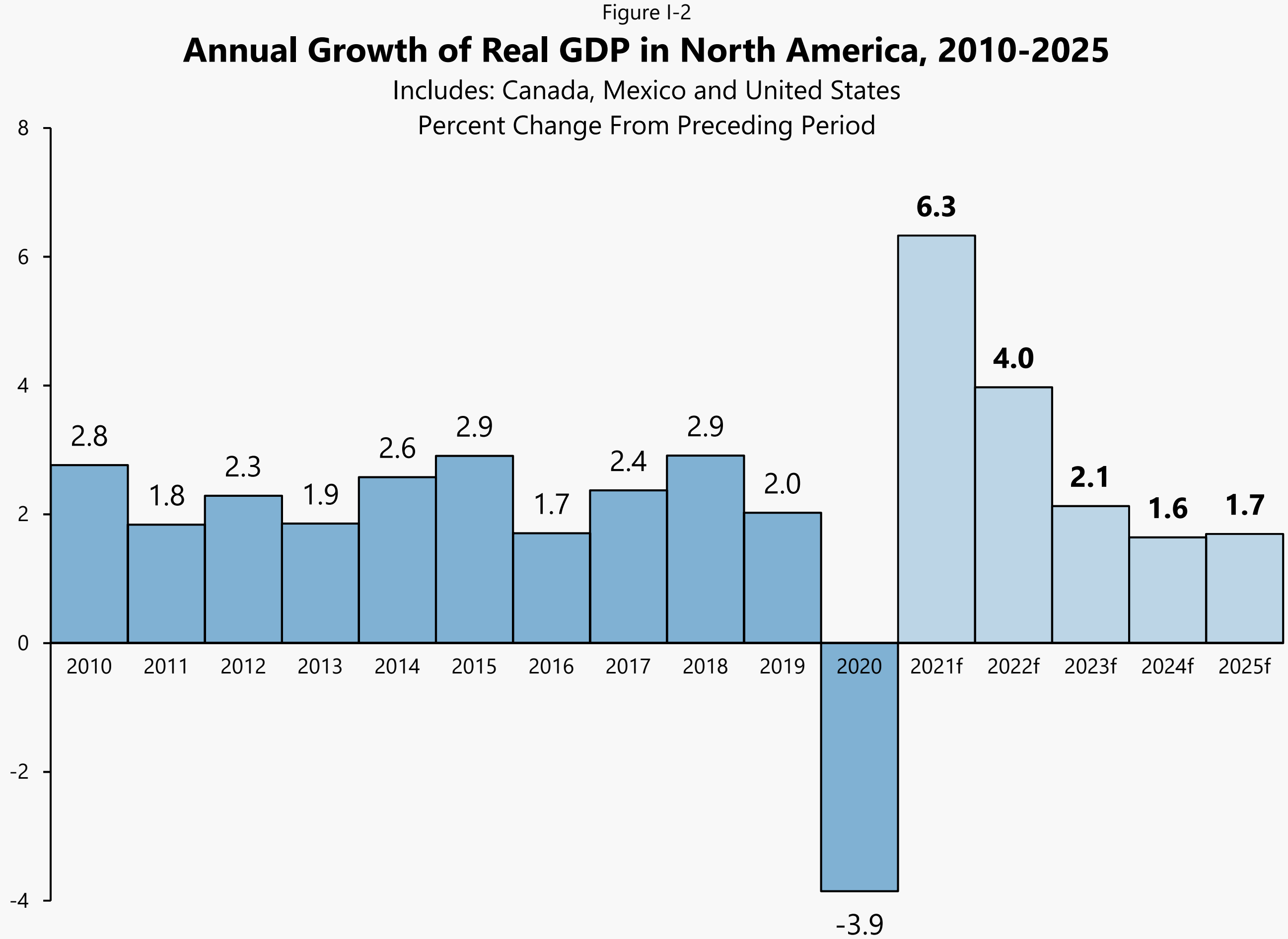
The North America region is comprised of Canada, Mexico and the United States of America. Within North America, the United States is the dominant economy in the region, accounting for 88.5% of the region's real gross domestic product (GDP) in 2020, the broadest measure of economic activity after adjusting for inflation. Canada accounts for 7.0% of the region's economic activity, followed by Mexico at 4.5%. This compares to 85%, 9%, and 6%, respectively, in 2010.

Just when it seemed that the pandemic was waning, the Delta variant popped up. The good news is that it's unlikely to derail the economy as its predecessor did earlier; the even better news is that economic fundamentals continue to remain strong. GDP will grow rapidly this year as the impact of the pandemic fades and the labor market recovers. Ample fiscal stimulus under the Biden administration and a loose monetary stance should also support activity. That said, uncertainty over new COVID-19 variants and ongoing tense relations with China pose downside risks.

Overall, the economic growth of North America is expected to average 3.2% annually through the forecast period (2021–2025). This compares to an annual growth of 1.3% in the last five years (2015–2020) and 1.8% in the last ten years (2010–2020) (Figure I-2).

The last issue of this report, the Worldwide Outlook for the Nonwovens Industry, 2018–2023, published in August of 2019, forecast North American growth of 1.9% in the forecast period of 2018–2023.

Figure I-2



Source: IMF and INDA/EDANA Estimates, 2021

Global Economic Share. Globally, the North American economic share has been steadily declining with the corresponding economic rise of China.

Table I-1

North American Share of Global GDP

Expressed in Percent of World GDP in PPP Dollars

	2010	2015	2020	2025
North America				
United States	16.9	16.5	16.0	15.1
Mexico	2.0	2.0	1.9	1.7
Canada	1.5	1.4	1.4	1.3
Total	**20.4**	**19.9**	**19.2**	**18.1**

Source: IMF, 2021

In 2010, the North America region accounted for 20.4% of the world's economies (GDP based on purchasing power parity), with the United States accounting for 16.9%. North America's share dropped to 19.2% in 2020 and is forecast to drop another percentage point by 2025 (Table I-1).

United States. The U.S. economy is forecast to expand rapidly over the next two years. Much of that growth stems from increases in consumer spending initially led by growth in spending on services. To fulfill the increased demand for their products, businesses increase both investment and hiring. In 2021, shortages in product and labor markets have put upward pressure on many prices and wages. Those shortages are projected to ease by the end of the year, relieving much of that upward pressure, as product markets adjust and as factors that discourage labor supply dissipate.

In all, U.S. growth is projected to reach 6.4%—its fastest pace since 1984—reflecting additional large-scale fiscal relief and the ongoing easing of pandemic restrictions. It is then expected to soften to a still-strong 4.0% in 2022 as the fiscal impulse begins to fade. The U.S. economy will then moderate to its potential output of two percent (driven by the nearly 0.4% annual growth of the potential labor force and 1.6% annual growth of potential labor force productivity).

Canada. Canadian GDP growth is seen expanding at a rapid pace this year as the impact of the pandemic fades. Pent-up demand and heightened household savings should support private spending, while a strong recovery in the U.S. and healthy fiscal and monetary stimulus should boost activity more broadly. However, uncertainty surrounding new variants of the virus clouds the outlook. Growth is forecast at 5.6% in 2021 and 4.2% in 2022, before moderating to 2.6% in 2023 and 1.7% in 2024 and 2025.

Mexico. After enduring one of the most severe economic contractions, the Mexican economy is set to recover in 2021 as rapid growth in the U.S. aids remittances and exports. However, weak fiscal support will drag on domestic demand. Moreover, a surge in COVID-19 cases, a still-slow vaccine rollout and an uncertain business environment cloud the outlook.

In Mexico, growth of 5.7% is projected for 2021, after an 8.2% contraction in 2020. The manufacturing industry, but also the services sector, is expected to benefit from increased export demand associated with robust growth in the United States, which receives four-fifths of Mexico's exports. While the growth in 2021 will be substantial, it will take some time for Mexico's output to return to pre-pandemic levels. Growth is forecast to soften to

3.0% in 2022 as the fiscal impulse in the United States fades, but domestic demand will be supported by growing COVID-19 vaccination coverage. Growth will then average two percent through 2023 to 2025.

GDP per Capita. GDP per capita is often linked by economists with standard of living; as GDP per capita rises, consumers have discretionary spending money, of which some is spent for the purchase of goods containing nonwoven material. It signifies economic growth when there is an increase in the nation's GDP per capita, and a decline in the economy if it follows a decreasing trend. GDP per capita serves as a benchmark in categorizing countries as developing, emerging, or advanced under the conditions of economic growth, standard of living, and many other essential factors.

Table I-2

North American Country GDP per Capita

Expressed in GDP in PPP Dollars per Person

In 2020 Economic Share Order

					AAGR	
	2010	2015	2020	2025	2010–2020	2021–2025
North America						
United States	48,403	56,849	63,416	78,660	2.7%	4.4%
Mexico	15,878	18,382	19,130	23,362	1.9%	4.1%
Canada	40,013	44,703	48,720	59,380	2.0%	4.0%

Source: IMF, 2021

Both the United States and Canada are defined as advanced economies or developed market by the International Monetary Fund (IMF), while Mexico is classified an emerging market country. Based on the World Bank country classifications, Mexico is a Upper-Middle-Income Economy. As such, Mexico has already passed the per capita threshold for absorbent hygiene products and wipes products. Mexico's GDP per capita growth is forecast to expand at a significantly faster rate through the five-year forecast period (4.1% annually) compared to the ten-year historical period (1.9% annually) (Table I-2).

Greater Europe

Since 2005, the definition of Europe used by EDANA in its nonwoven statistics is **Greater Europe** which includes all the countries of Western, Central and Eastern Europe. Greater Europe also includes Turkey and the Commonwealth of Independent States (Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan). The term Greater Europe is used to refer to these 51 countries that accounted for a quarter (24.7)% of the world's economic output in 2020. Within the region, six of the countries account for slightly less than two-thirds (60.2%) of the region's economic activity: Germany (14%), Russia (13%), France (9%), United Kingdom (9%), Turkey (8%), and Italy (5%).

In terms of economic development, Greater Europe is very heterogeneous, gathering together advanced and developing countries. Therefore, there is wide divergence within the region. The improving health situation and ensuing continued easing of virus containment measures are putting the Greater European economies back in motion. A significant economic rebound is projected in 2021, reflecting the expected re-opening of the economy, strengthened policy support and the ongoing global recovery.

The regional economy is projected to grow 4.9% in 2021, with firming external demand and higher industrial commodity prices offsetting the negative impact of recent resurgences in new COVID-19 cases. Regional growth is forecast to expand 4.3% in 2022 as the recovery in domestic demand gains traction, before moderating to two-percent in the later years (2023–2025) of the forecast (Table I-3).

Overall, Greater Europe's growth is expected to average 3.0% annually through the forecast period (2021–2025). This compares to an annual growth of 0.8% in the preceding five years and annual growth of 1.2% in the preceding ten (Figure I-3).

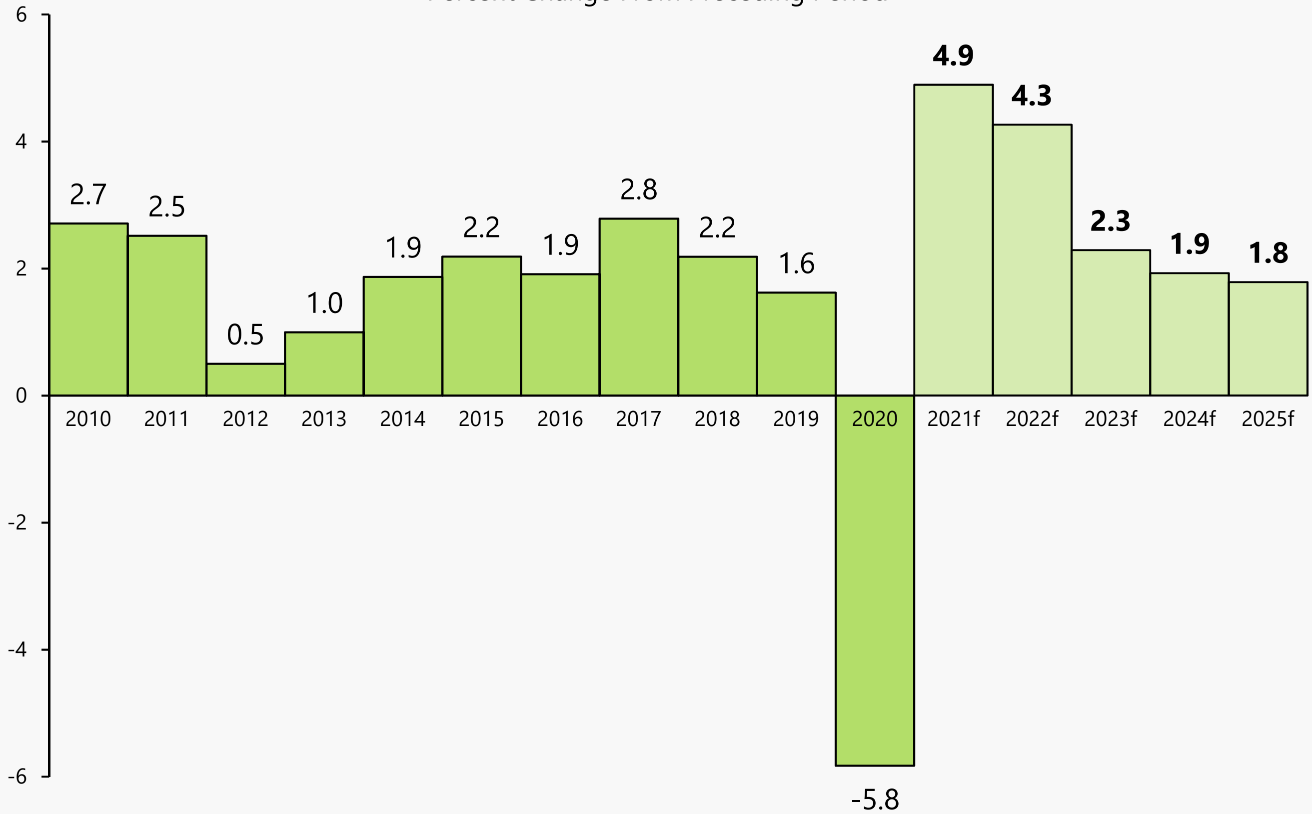
The last issue of this report, the Worldwide Outlook for the Nonwovens Industry, 2018–2023, published in August of 2019, forecast Greater Europe growth of 1.7% in the forecast period of 2018–2023. In the later years of the forecast period (2023–2025) and after the rebound from the pandemic, the growth is projected at 2.0%.

The outlook remains uncertain, however, with uneven vaccine rollouts and the withdrawal of macroeconomic support measures weighing on the regional recovery. Growth could be weaker than projected if the pandemic takes longer than expected to abate, external financing conditions tighten, or geopolitical instability.

Figure I-3

Annual Growth of Real GDP in Greater Europe, 2010-2025

Includes: 51 Countries in Western, Central and Eastern Europe, including C.I.S. and Turkey
Percent Change From Preceding Period



Source: IMF and INDA/EDANA Estimates, 2021

Global Economic Share. Similar to North America, the economic share—at purchasing power parity (PPP)—of Greater Europe has been steadily declining, even with the rise of Turkey, given the corresponding economic rise of the Asian economies. In 2010, the Greater Europe region accounted for 26% of the world's economies (GDP based on purchasing power parity), with Western Europe accounting for 17% in 2010. That has since declined to 25% and 15%, respectively. The Western Europe and Commonwealth of Independent States (CIS) decline has been somewhat offset by the growth of Central Europe, whose share rose nearly a percentage-point globally from 2010 to 2020 (Table I-3).

Table I-3

Greater European Share of Global GDP

Expressed in Percent of World GDP in PPP Dollars

	2010	2015	2020	2025
Western Europe				
Germany	3.6	3.5	3.4	3.1
France	2.6	2.4	2.3	2.2
United Kingdom	2.5	2.5	2.2	2.1
Italy	2.4	2.0	1.9	1.7
Spain	1.6	1.5	1.4	1.3
Remaining Countries	4.5	4.2	4.2	3.9
Total	17.2	16.1	15.4	14.4
Central Europe				
Turkey	1.4	1.8	1.9	1.9
Remaining Countries	2.7	2.6	2.8	2.8
Total	4.1	4.5	4.7	4.7
Commonwealth of Independent States				
Russia	3.4	3.2	3.1	2.9
Remaining Countries	1.4	1.4	1.5	1.4
Total	**4.8**	**4.6**	**4.6**	**4.3**
Total	**26.1**	**25.2**	**24.7**	**23.4**

Source: IMF, 2021

Western Europe. In Western Europe, the strong expected economic recovery of 2022 is sustained by relatively fast relaxation of pandemic restrictions, a high level of household savings to spend combined with a large increase in consumer confidence, and significant fiscal stimulus from the EU Recovery and Resilience Facility. The Recovery and Resilience Facility funds are expected to boost EU economic output levels by 1.2% at the end of 2022.

However, while an even stronger consumer boom, driven by accumulated savings, is a clear upside scenario, risk factors persist. The Delta variant of the coronavirus has spread in Europe, especially in the Netherlands and Spain, where some restrictions had to be reintroduced. If rising infection rates lead to a new round of lockdowns and new travel restrictions, the Western Europe's growth prospects would fade substantially. Also, continued shortages of semiconductors and other inputs pose a risk. Despite these factors, the economic situation and the outlook for Western Europe look better than at any time during the COVID-19 crisis.

Overall, Western Europe GDP is forecast to grow by 4.7% in 2021 and 4.4% in 2022. Real GDP growth is projected to slow in the later years of the forecast period (2023-2025) to a more normal rate, 1.8% annual growth. Through the five-year forecast period, growth is projected to expand at an annual rate of 2.8%.

The volume of output is projected to return to its pre-crisis level (2019-Q4) in the last quarter of 2021. However, economic activity in the fourth quarter of 2022 would remain about 1% shy of the level that was expected before the pandemic. The speed of the recovery will vary significantly across countries. Some are expected to see economic output return to their pre-pandemic levels by the third quarter of 2021, but others would take longer. Among the largest countries, Germany and the Netherlands are expected to have returned to pre-crisis levels of output in 2021-Q3, while Spain and Italy will do so one year after, in 2022-Q3.

Central Europe. The regional economy is set to expand at a solid pace in 2021, expanding 5.9%, amid the gradual easing of restrictions. Recovering foreign demand should support exports, while inflows of EU funding and expansionary fiscal policies are set to fuel domestic demand. However, uncertainty over new COVID-19 variants and the speed of vaccination campaigns clouds the outlook.

The Turkish economy is forecast to grow at a stronger pace this year, 6.0%, amid the gradual relaxation of domestic and foreign lockdown measures, which should buoy domestic and external demand in turn. However, the balance of risks is tilted to the downside due to elevated inflation, currency weakness and a frail external position

Through the five-year forecast period, growth is projected to expand at an annual rate of 4.0%; this compares to 5.1% annually in the ten-year historical period (2010–2020).

Commonwealth of Independent States. The CIS economy is set to rebound in 2021, bolstered by easing pandemic-related restrictions. Rejuvenated domestic demand in heavyweight Russia, accounting for three-quarters (72%) of the region's economic activity in 2020, should translate into healthier remittance inflows for smaller economies, while higher commodity prices bode well for the region's exports. Geopolitical tensions and new COVID-19 strains cloud the outlook, however.

In Russia, an accelerating vaccination campaign, improving private sector confidence and rising global oil and gas prices will help achieve stronger-than-previously-anticipated Russian economic recovery in 2021. The Russian economy is expected to reach 2019 levels at the end of 2021. On top of the growing oil and gas prices, the output from the recovering manufacturing sector and the country's stimulus package of around 2.6% of GDP will facilitate additional support for local pandemic-torn businesses.

Through the five-year forecast period, growth is projected to expand at an annual rate of 2.9%; this compares to 2.0% annually in the ten-year historical period (2010–2020).

GDP per Capita. The annual per capita GDP of a country is closely related to the probability of purchasing consumer goods, notably nonwoven absorbent hygiene products. It is generally assumed that people are beginning to prepurchase feminine care products only when their per capita GDP reaches $1,000. When GDP per capita reaches $3,500, consumers tend to start buying baby diapers, and above $7,000, baby wipes, and above $10,000, the incontinence market purchases begin. Only a few of the CIS countries have GDP per capita below $10,000 in 2020.

Greater European GDP per capita varies greatly across and also within the region's groupings. All of the Western European countries are advanced economies with GDP per capita ranging from Greece at just below $29,000 to Luxembourg at $118,000. The Central European countries range from the advanced economy of the Czech Republic at $41,000 to the developing economy of Kosovo just over $11,000. Central Europe includes a mix of advanced, emerging market and developing economies. The CIS is comprised of just emerging market and developing economies with GDP per capita ranging from the emerging economies of Russia at nearly $30,000 to the developing economies of Tajikistan and the Kyrgyz Republic, both $5,000 or below (Table I-4, continued on the next two pages).

Table I-4

Greater European Country GDP per Capita

Expressed in GDP in PPP Dollars per Person

In 2020 Economic Share Order

					AAGR	
	2010	2015	2020	2025	2010–2020	2021–2025
Western Europe						
Germany	40,097	47,622	54,076	66,704	3.0%	4.3%
France	37,361	42,289	46,062	58,096	2.1%	4.8%
United Kingdom	36,236	42,583	44,117	55,868	2.0%	4.8%
Italy	35,402	36,870	40,861	50,683	1.4%	4.4%
Spain	31,594	34,939	38,392	49,759	2.0%	5.3%
Netherlands	45,269	50,419	57,534	70,375	2.4%	4.1%
Switzerland	56,612	66,400	72,874	84,594	2.6%	3.0%
Belgium	40,158	46,365	51,096	62,677	2.4%	4.2%
Sweden	42,494	48,858	54,146	64,055	2.5%	3.4%
Austria	42,461	49,955	55,218	68,247	2.7%	4.3%
Ireland	43,860	68,973	94,392	119,361	8.0%	4.8%
Norway	60,767	60,190	65,800	81,841	0.8%	4.5%
Portugal	26,635	29,669	34,043	44,350	2.5%	5.4%
Denmark	43,199	49,265	58,933	71,790	3.2%	4.0%
Greece	27,950	26,637	28,748	37,352	0.3%	5.4%
Finland	39,353	42,570	49,853	60,198	2.4%	3.8%
Luxembourg	90,741	104,976	118,002	139,277	2.7%	3.4%
Cyprus	33,761	31,848	40,107	48,907	1.7%	4.0%
Malta	28,401	37,922	42,856	57,583	4.2%	6.1%
Iceland	39,544	49,471	55,966	67,358	3.5%	3.8%
San Marino	63,044	56,138	58,427	71,139	-0.8%	4.0%

Source: IMF, 2021

Continued

Table I-4 Continued

Greater European Country GDP per Capita

Expressed in GDP in PPP Dollars per Person

In 2020 Economic Share Order

					AAGR	
	2010	2015	2020	2025	2010–2020	2021–2025
Central Europe						
Turkey	17,374	25,691	30,253	38,561	5.7%	5.0%
Poland	21,368	26,856	34,103	45,325	4.8%	5.9%
Romania	17,077	21,547	30,526	41,895	6.0%	6.5%
Czech Republic	28,007	33,933	40,618	53,415	3.8%	5.6%
Hungary	22,008	26,749	33,030	44,514	4.1%	6.1%
Slovak Republic	24,879	29,941	32,710	43,418	2.8%	5.8%
Bulgaria	14,681	18,410	23,817	32,764	5.0%	6.6%
Serbia	13,102	14,932	19,146	26,704	3.9%	6.9%
Croatia	19,784	23,009	27,717	38,791	3.4%	7.0%
Lithuania	20,668	28,842	38,824	49,806	6.5%	5.1%
Slovenia	28,178	31,647	38,807	50,729	3.3%	5.5%
Latvia	17,765	24,860	31,509	42,653	5.9%	6.2%
Bosnia & Herzegovina	9,565	12,014	15,047	19,889	4.6%	5.7%
Estonia	22,527	29,397	37,745	49,666	5.3%	5.6%
Albania	9,724	11,662	14,218	19,327	3.9%	6.3%
North Macedonia	11,196	13,885	16,712	22,215	4.1%	5.9%
Kosovo	7,786	9,666	11,274	15,192	3.8%	6.1%
Montenegro	13,752	16,336	19,252	27,060	3.4%	7.0%
CIS						
Russia	21,270	24,062	27,903	35,426	2.8%	4.9%
Ukraine	8,295	10,225	13,110	17,803	4.7%	6.3%
Kazakhstan	19,086	23,057	26,565	33,294	3.4%	4.6%
Uzbekistan	5,227	6,400	7,449	9,844	3.6%	5.7%
Belarus	15,347	18,058	20,187	24,156	2.8%	3.7%
Azerbaijan	15,021	15,026	14,431	16,502	-0.4%	2.7%
Turkmenistan	9,809	13,691	16,521	21,203	5.4%	5.1%
Georgia	7,541	12,100	14,918	21,150	7.1%	7.2%
Armenia	7,281	9,753	13,261	17,696	6.2%	5.9%
Tajikistan	2,294	2,958	3,676	4,599	4.8%	4.6%
Moldova	6,369	9,222	12,811	19,103	7.2%	8.3%
Kyrgyz Republic	3,103	4,259	5,036	6,307	5.0%	4.6%

Source: IMF, 2021

Asia

Asia—for the purpose of this report—is defined as a 37-country region including Asia, South East Asia and the Pacific Islands. China is by far the dominant economy in the region accounting for 51% of the region's economic activity. More so, the top five countries account for 87% of the region's activity. Besides China, the other countries are: Japan (17%), India (9%), South Korea (6%), and Indonesia (4%).

Asia escaped the worst of the COVID-19 pandemic in 2020, but the virus has returned with a vengeance in 2021. However, lockdown measures will be less stringent than in 2020 and, in many instances, shorter in duration than last year. The pace of recovery from the coronavirus-induced slump in 2020 will be uneven across the region. Export-oriented economies, particularly those that manufacture personal protective equipment and semiconductors, will benefit from a pick-up in external demand, and those that export commodities should benefit from higher global prices. These global trends will help countries such as South Korea and Taiwan to stage full recoveries to pre-coronavirus (2019) GDP levels this year. China will remain an exception—early containment of the pandemic means that the country did not record a recession in 2020, as the majority of countries in the region experienced.

The pace of recovery in the global tourism sector will influence the timeline for the recovery of many Asian economies. It is not expected that global tourist arrivals or expenditures will return to pre-pandemic levels until 2023. As a result, those Asian countries that rely heavily on tourism to drive overall economic activity, like Thailand, will struggle to increase tourist receipts significantly, as major source markets (such as the EU and China) are likely to either caution against leisure travel or extend quarantine measures to shield themselves from new COVID-19 variants.

The slow vaccine rollouts in most Asian countries and uncertainty surrounding the epidemiological path of the virus pose considerable downside risks to GDP projections for 2021 and 2022. If responses to surges of COVID-19 are more prolonged and stringent than in 2020, they will exert a drag on the region's overall performance. The decision of the governments of Japan and Malaysia to tighten restrictions in April and extend them for many more months thereafter highlights this risk. With a few notable exceptions, such as China, Singapore, Bhutan and Mongolia, which have managed to fully vaccinate large shares of their populations, the rest of Asia lags considerably and will not achieve mass inoculation until 2022.

Nonetheless, regional GDP growth should accelerate robustly this year as external demand rebounds, expanding at an annual rate of 7.2%, primarily reflecting strong activity in China. Fiscal and monetary stimulus should further support the bounce-back, while less volatile U.S. foreign policy under President Biden bodes well for trade.

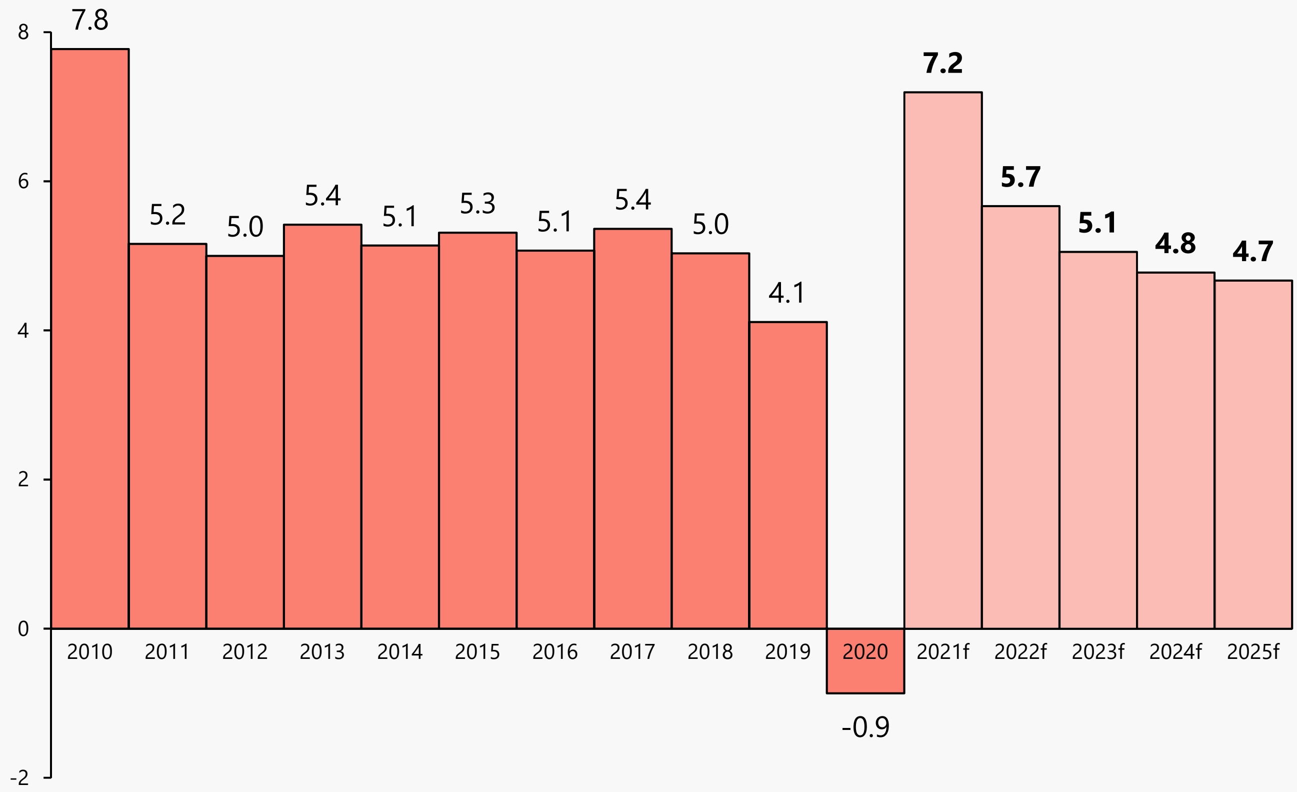
In China, growth is projected to accelerate to 8.4% in 2021, supported by buoyant exports and the release of pent-up demand amid effective control of the outbreak. Output in the rest of the region is projected to grow by 5.6% in 2021, because of continued pandemic-related headwinds and a delayed recovery of global tourism and travel. Nevertheless, output in two-thirds of the countries in the region will remain below pre-pandemic levels until 2022.

Figure I-4

Annual Growth of Real GDP in Asia, 2010-2025

Includes: 37 Countries in Asia

Percent Change From Preceding Period



Source: IMF and INDA/EDANA Estimates, 2021

The Asian economies are capturing a greater share of the global economies at the expense of Greater Europe and North America, having grown 4.1 points between 2013 and 2018 and forecast to capture another 3.9 points through the forecast period (Table I-5).

The regional recovery is expected to moderate in 2022 to 5.7% annual growth as China's growth edges down toward its potential rate. Growth in China is projected to moderate to 5.6% in 2022, reflecting diminishing fiscal and monetary support and tighter property and macroprudential regulations.

Asia's growth is forecast to average 5.5% annually through the forecast period (2021–2025), which is above, as a result of the pandemic rebound, both the previous five-year annual average (4.0%) and the previous ten-years averages (4.9%) (Figure I-4).

The last issue of this report, the Worldwide Outlook for the Nonwovens Industry, 2018–2023, published in August of 2019, forecast Asian growth, at a surprisingly similar rate, of 4.9% in the forecast period of 2018–2023. Dropping 2021 from the forecast period, the four-year average (2022–2025) is 5.0%.

China. After expanding 2.3% in 2020, output in China has continued to recover, gradually broadening from public investment and exports to domestic consumption. Policy has been shifting away from buttressing activity and toward reducing financial stability risks. Credit support and infrastructure spending, which initially fueled much of the acceleration in investment, have moderated. Debt defaults, including for state-owned enterprises, have continued to rise. That said, further domestic COVID-19 outbreaks are a key risk given the government's zero-tolerance approach, while tense relations with the West, elevated corporate debt levels and regulatory clamp-downs further cloud the outlook.

China's growth is forecast to rebound to 8.4% this year, reflecting the release of pent-up demand. Amid diminishing fiscal and monetary support and tighter property and macroprudential regulations, growth is expected to moderate in 2022, to 5.6%, before slowing to an average of 5.1% annual growth through the last three years of the forecast period (2023–2025).

The Demographic Challenge for China and Its Implications

China has been in the news lately for rapidly easing restrictions on the number of children that families can have. This shift in policy reflects a recognition that China has a serious demographic problem. The low birth rate in the past has led to a shortage of labor, a decline in the working age population, the prospect of slower economic growth, and a decline in the ratio of workers to retirees. The latter creates stress for the country's system of pensions and health care. China's president said that an aging population is a threat to national security. In response to this crisis, the one child policy applied to urban households was first eased to two children several years ago and, more recently, to three children. Moreover, it is reported that the government is considering eliminating all such restrictions.

And yet, despite these actions, the birth rate continues to fall. Last year the number of live births was the lowest since 1961. In addition, it is reported that the infertility rate in China has increased substantially, from 12% in 2007 to 18% in 2020. It is reported that 5.6% of couples are having difficulty bearing children. A government scientist said that "besides age-related infertility, infertility is probably affected by environmental exposures, chromosome abnormalities, lifestyles and unexplained factors." The trajectory of China's economy in the coming decades will be significantly influenced by the success or failure of policies meant to boost the number of children.

Japan. The Japanese economy is projected to recover this year. Improving consumer and capital spending, bolstered by continued fiscal stimulus, will drive domestic activity, while strengthening foreign demand will see exports surge. However, the economic impact of the ongoing state of emergency and surging COVID-19 cases is a key risk to growth.

Even so, GDP is projected to only expand by 3.3% in 2021 and 2.5% in 2022, supported by the strong recovery of the global economy and government spending. As restrictions are lifted, and with government support, consumption is expected to recover. Still, subdued wage and employment growth will limit the pick-up in consumption, but stronger external demand will boost exports and support stronger investment.

India. After the 2020 huge GDP contraction (–8.0%) of the Indian economy, economic growth is projected to bounce back in 2021 (+12.5%) , driven by pent-up demand for consumer and investment goods, before slightly slowing in 2022 (+6.9%).

Global Economic Share. The Asian economies are capturing a greater share of the global economies at the expense of Greater Europe and North America, having grown 5.6 percentage points between 2010 and 2020 and forecast to capture another 2.9 points through the forecast period (Table I-5).

Table I-5

Asian Share of Global GDP

Expressed in Percent of World GDP in PPP Dollars

	2010	2015	2020	2025
Advanced Economies				
Japan	5.1	4.7	4.0	3.6
Korea	1.7	1.7	1.8	1.6
Taiwan Province of China	1.0	1.0	1.0	0.9
Singapore	0.4	0.4	0.4	0.4
Hong Kong SAR	0.4	0.4	0.3	0.3
Total	**8.6**	**8.2**	**7.6**	**6.9**
China				
Total	**13.7**	**16.1**	**18.3**	**20.1**
India				
Total	**5.8**	**6.4**	**6.8**	**8.1**
ASEAN (less Singapore)				
Indonesia	2.3	2.4	2.5	2.7
Remaining Countries	2.0	2.3	2.5	2.8
Total	**4.3**	**4.6**	**5.0**	**5.4**
Other Asia				
Thailand	1.0	1.0	1.0	1.0
Pakistan	0.8	0.8	0.8	0.8
Remaining Countries	0.8	1.0	1.1	1.2
Total	**2.6**	**2.7**	**2.9**	**3.0**
Total	**35.0**	**38.2**	**40.6**	**43.6**

Source: IMF, 2021

GDP per Capita. The annual per capita GDP of a country is closely related to the probability of purchasing consumer goods, notably nonwoven absorbent hygiene products. It is generally assumed that people are beginning to prepurchase feminine care products only when their per capita GDP reaches $1,000. When GDP per capita reaches $3,500, consumers tend to start buying baby diapers, and above $7,000, baby wipes, and above $10,000, the incontinence market purchases begin.

Through the forecast period the Philippines, Laos, and India pass through the US$10,000 incontinent product usage threshold. Bangladesh passes, while Myanmar and Cambodia are both approaching the US$7,000 baby wipes threshold. The table below highlights, in yellow, when those thresholds are met from the 2020 to 2025 period (Table I-6).

As with Greater Europe, GDP per capita varies greatly across the region's groupings and also within the region's groupings. The majority of the Asian countries are emerging market and developing economies, with the exceptions of Japan, Korea, Taiwan, Singapore and Hong Kong. In 2020, the advanced economies accounted for 18% of the region's economic activity with GDP per capita ranging from Japan at $43,000 to Singapore at nearly $100,000.

Comparing the Chinese GDP per capita at $17,000 to the Indian GDP per capita at $6,500, one can see the clear economic opportunity in India that may finally begin to be realized towards the later years of the forecast. However, even by 2025 the Indian GDP per capita rises to just over $10,000, while the Chinese rises to over $25,000. India does close the gap, somewhat, with GDP per capita expanding at 9.1% a year, compared to China at 8.0%.

The remaining ASEAN and other countries represent a mix of emerging and developing economies with per capita GDP ranging from the extreme outlier of Brunei Darussalam at nearly $80,000, supported by extensive petroleum and natural gas fields (the next highest ASEAN and other country's GDP per capita is Malaysia at $37,000), to two countries just above $2,000 (Afghanistan and Kiribati) (Table I-6).

China. China faces pressing economic challenges in the near term. More immediately, the Chinese authorities face the challenge of supporting economic growth while limiting financial risks. Economic growth in China, despite fiscal stimulus and no further increase in tariffs from the United States, is projected to slow on an annualized basis in 2019 and 2020 to 6.4% and 6.3%, respectively. While growth will slow in China, it is still sufficient for the government to meet its target of doubling the size of the economy this decade without seriously jeopardizing financial stability.

Japan. Japan's economy is set to grow by 1.0% in 2019. This revision mainly reflects additional fiscal support this year, including measures to mitigate the effects of the planned consumption tax rate increase in October 2019 and the frantic front-loading of consumer purchases ahead of the increase. Growth is then projected to moderate to 0.5% in 2020 and maintain that same rate through the forecast period.

India. The Indian economy seems set to regain some momentum later in 2019. Growth is projected to pick up to 7.3% in 2019 and 7.5% in 2020, supported by the continued recovery of investment and robust consumption amid a more expansionary stance of monetary policy and some expected impetus from fiscal policy.

As with Greater Europe, GDP per capita varies greatly across the region's groupings and also within the region's groupings. The majority of the Asian countries are emerging market and developing economies, with the exceptions of Japan, Korea, Taiwan, Singapore and Hong Kong. In 2018, the advanced economies accounted for 18% of the region's economic activity with GDP per capita ranging from Korea at $41,000 to Singapore at just over $100,000. Comparing the Chinese GDP per capita at $18,000 to the Indian at nearly $8,000, one can see the clear economic opportunity in India that may finally begin to be realized towards the later years of the forecast. The remaining ASEAN and other countries represent a mix of emerging and developing economies with per capita GDP ranging from the extreme outlier of Brunei Darussalam at nearly $80,000, supported by extensive petroleum and natural gas fields (the next highest ASEAN and other country's GDP per capita is Malaysia at $30,000), to two countries just above $2,000 (Afghanistan and Kiribati) (Table I-6).

Table I-6

Asian Country GDP per Capita

Expressed in GDP in PPP Dollars per Person

In 2020 Economic Share Order

					AAGR	
	2010	2015	2020	2025	2010–2020	2021–2025
Advanced Economies						
Japan	35,531	40,959	42,248	51,895	1.7%	4.2%
Korea	30,985	37,908	44,621	56,418	3.7%	4.8%
Taiwan	38,400	46,911	55,724	71,121	3.8%	5.0%
Singapore	75,294	86,975	97,057	119,144	2.6%	4.2%
Hong Kong SAR	48,991	56,267	59,520	75,460	2.0%	4.9%

Source: IMF, 2021

Continued

Table I-6 Continued

Asian Country GDP per Capita

Expressed in GDP in PPP Dollars per Person

In 2020 Economic Share Order

	2010	2015	2020	2025	AAGR 2010–2020	AAGR 2021–2025
ASEAN						
Indonesia	8,656	10,359	12,222	16,757	3.5%	6.5%
Vietnam	5,356	7,635	10,869	16,038	7.3%	8.1%
Philippines	5,676	7,278	8,452	11,948	4.1%	7.2%
Malaysia	20,523	24,074	27,402	37,688	2.9%	6.6%
Myanmar	3,095	4,224	5,242	6,018	5.4%	2.8%
Cambodia	2,438	3,501	4,695	6,610	6.8%	7.1%
Lao P.D.R.	3,917	6,168	8,111	10,986	7.5%	6.3%
Brunei Darussalam	80,660	62,922	62,371	76,009	-2.5%	4.0%
Other						
China	9,166	13,007	17,192	25,212	6.5%	8.0%
India	4,181	5,465	6,461	10,002	4.4%	9.1%
Thailand	13,195	15,822	18,236	24,193	3.3%	5.8%
Pakistan	4,030	4,593	5,150	6,329	2.5%	4.2%
Bangladesh	2,624	3,810	5,307	8,094	7.3%	8.8%
Sri Lanka	8,194	11,557	13,215	17,372	4.9%	5.6%
Nepal	2,170	2,996	4,061	5,314	6.5%	5.5%
Afghanistan	1,908	2,535	2,390	2,906	2.3%	4.0%
Mongolia	7,469	10,558	11,825	15,969	4.7%	6.2%
Papua New Guinea	2,891	3,531	3,833	4,467	2.9%	3.1%
Fiji	8,678	12,401	11,567	16,521	2.9%	7.4%
Bhutan	6,267	9,239	12,060	15,875	6.8%	5.7%
Timor-Leste	1,965	2,913	3,382	3,441	5.6%	0.3%
Maldives	14,527	21,931	19,609	34,081	3.0%	11.7%
Solomon Islands	1,951	2,245	2,455	2,873	2.3%	3.2%
Vanuatu	2,357	2,481	2,586	3,000	0.9%	3.0%
Samoa	4,685	5,088	5,653	6,140	1.9%	1.7%
Palau	10,980	14,453	14,309	17,614	2.7%	4.2%
Kiribati	1,546	1,915	2,200	2,495	3.6%	2.6%
Nauru	4,892	8,973	9,856	10,351	0.0%	0.0%
Tonga	4,135	5,074	6,191	7,507	4.1%	3.9%
Marshall Islands	2,961	3,208	3,786	4,376	2.5%	2.9%
Micronesia	2,878	3,097	3,446	3,872	1.8%	2.4%

Source: IMF, 2021

South America

The Central and South America region is comprised of 33 countries: 7 in Central America, 13 in the Caribbean and 13 in South America. Within Central/South America, South America is the dominant economy, accounting for 86% of the region's real gross domestic product in 2020. Within the continent South America, Brazil accounts for half (50%) of economic output, followed by Argentina (14%), then Colombia (10%). Venezuela's share of the economic output with the continent of South America has fallen significantly from 9% of the continent's economic output in 2015 to just 2% in 2020. For the purpose of the report, South America includes Central America, South America and the Caribbean.

The COVID-19 pandemic is likely to have a long-lasting economic and social impact on the region, and it may take several years before the damage is reversed. COVID-19 hit the South American region hard. As of July 2021, the region had almost a third of the world's COVID-19 deaths, with only eight percent of the global population. Moreover, because of pandemic-related restrictions, its GDP contracted by 6.5% in 2020, the worst result in more than a century.

South America is gradually emerging from a second wave of COVID-19, with infections having peaked in most countries in the second quarter of 2021. Nonetheless, the region is far from having the pandemic fully under control. To the contrary, it faces significant threats from the spread of new COVID-19 strains, including the Delta variant. That said, even in the event of an upsurge in COVID-19 cases, one would expect governments to hold off on the type of blanket lock-downs that were imposed in 2020, opting instead for targeted restrictions which will help to minimize disruption to economic activity and employment. The prospect of a prolonged pandemic is sapping consumer and business confidence in a region that has high rates of labor informality, inadequate social safety nets and fragmented health systems.

Economic performance in the coming year will depend on several factors, including the scope of new coronavirus outbreaks, the extent and composition of fiscal support measures, and confidence in government and policy effectiveness. Institutional capacity will be critical in determining which countries roll out their COVID-19 vaccines the fastest and return to normality the soonest. Among the major economies, Chile and Uruguay have so far been the best performers in the region, having fully vaccinated more than 60% of their populations. However, in much of the rest of the South American region, governments have faced significant problems procuring and distributing vaccines, and it is therefore believed that most countries will not reach game-changing immunization levels (defined as 60-70% of their population) until mid-2022 at the earliest.

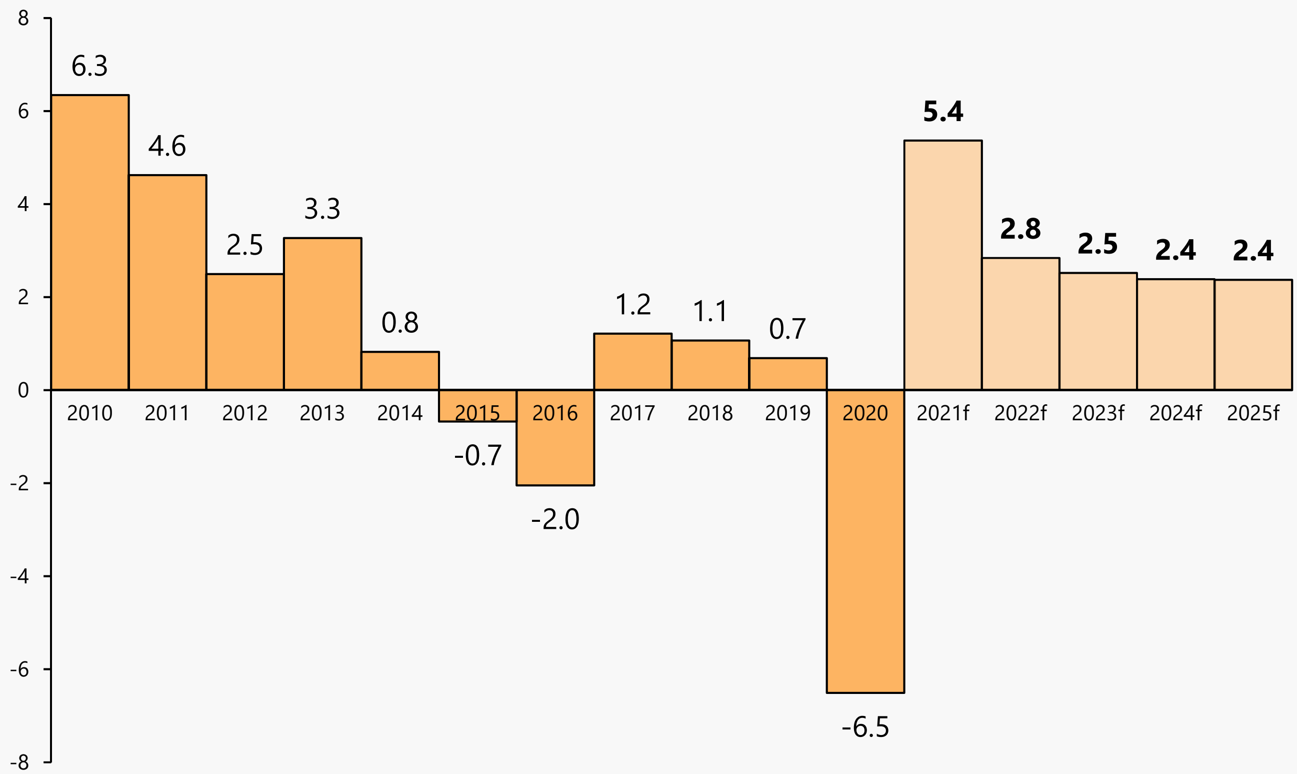
The region's economic activity is projected to grow 5.4% in 2021, a rebound insufficient to return GDP to 2019 levels this year after a historically deep recession in 2020. By the end of the year, GDP figures of the better-performing countries (i.e. Guatemala, Paraguay, and maybe Colombia) should reach their pre-pandemic levels. Tourism-reliant economies are projected to take longer than commodity-exporting economies to reach 2019 levels of output. Per capita income losses will still be deep in 2022, particularly for small island economies in the Caribbean.

The region's further rebound will be supported by moderate progress in vaccine rollouts, relaxation of mobility restrictions, and improved external economic conditions. Growth in 2022 is projected to soften, to 2.8%, as the boost from these factors wanes, and an average of 2.4% through the last three years (Figure I-5).

Figure I-5

Annual Growth of Real GDP in South America, 2010-2025

Includes: 33 Countires in the Caribbean, Central America and South America
Percent Change From Preceding Period



Source: IMF and INDA/EDANA Estimates, 2021

Overall, the South America region's growth is expected to average 3.1% annually through the forecast period (2021–2025). This compares to an annual growth of –1.0% the previous five years (2015–2020) and 1.0% in the previous ten, both of which were impacted by the downturn in 2015 and 2016 (Figure I-5).

The last issue of this report, the Worldwide Outlook for the Nonwovens Industry, 2018–2023, published in August of 2019, forecast the South American regional growth of 2.2% in the forecast period of 2018–2023.

Global Economic Share. Globally, the region's economic share is in decline, accounting for 6.7% of the world's economic output in 2010, dropping to 5.4% in 2020 and a projected decline to 5.1% in 2025. This is more than the drastic impact of Venezuela, with both Brazil and Argentina also declining in the global economic share. (Table I-7).

Table I-7

South American Share of Global GDP

Expressed in Percent of World GDP in PPP Dollars

	2010	2015	2020	2025
South America				
Brazil	3.1	2.7	2.4	2.2
Argentina	0.8	0.8	0.7	0.7
Colombia	0.5	0.6	0.6	0.6
Chile	0.4	0.4	0.3	0.3
Peru	0.3	0.3	0.3	0.3
Ecuador	0.2	0.2	0.1	0.1
Venezuela	0.5	0.5	0.1	n/a
Remaining Countries	0.3	0.3	0.3	0.3
Total	**6.1**	**5.6**	**4.8**	**4.5**
Central America				
Total	**0.3**	**0.4**	**0.4**	**0.4**
Caribbean				
Total	**0.2**	**0.2**	**0.2**	**0.2**
Total	**6.7**	**6.2**	**5.4**	**5.1**

Source: IMF, 2021

Brazil. Brazil labored through its deepest economic downturn in recent memory in the first half of 2020. And while the economy witnessed a recovery of sorts in the second half, the scars of the pandemic still run deep. A surge in new COVID-19 cases in 2021 has again soured sentiment and weighed on economic activity. With the pandemic continuing with its volatile trajectory, vaccination numbers still low relative to the population size, and with rising inflationary pressures, it is unlikely that private consumption will witness a strong surge in growth soon. Businesses too have been affected by the pandemic, with sentiment bruised and earnings dented, especially in the services sector. With policymakers now almost empty of any fiscal or monetary firepower after a year of stimulus, further policy support is unlikely. The path to a near-term recovery, therefore, likely lies in faster vaccinations to gain control over the pandemic, thereby allowing consumers and businesses to operate freely and without fear.

Economic activity is poised to recover in 2021, underpinned by sturdier domestic and external demand as vaccines are rolled out and restrictions are gradually lifted. However, frail fiscal accounts, a heavy debt burden and political polarization represent key risks. Brazil's economy is projected to expand by 4.8% in 2021 and then moderate to 2.1% in 2022 as domestic policy support is withdrawn and external conditions become less supportive. Output will improve through the later years, averaging 2.5% a year in the period of 2023–2025.

GDP per Capita. The annual per capita GDP of a country is closely related to the probability of purchasing consumer goods, notably nonwoven absorbent hygiene products. It is generally assumed that people are beginning to prepurchase feminine care products only when their per capita GDP reaches $1,000. When GDP per capita reaches $3,500, consumers tend to start buying baby diapers, and above $7,000, baby wipes, and above $10,000, the incontinence market purchases begin. The chart below highlights, in yellow, when these thresholds are met from the 2020 to 2025 period

Through the forecast period Bolivia, Guatemala, Costa Rica, and Jamaica pass through the US$10,000 incontinent product usage threshold. Belize passes, while Honduras and Nicaragua are both approaching the US$7,000 baby wipes threshold. The table below highlights, in pale yellow, when those thresholds are meet from the 2020 to 2025 period (Table I-8).

All of the South American countries are classified as emerging market and developing economies. South American GDP per capita by country ranges from Trinidad and Tobago at $25,000 to free-falling Venezuela at just over $5,000 (down from a recent peak of nearly $19,000 in 2013). Brazil, which accounts for half of the region's economic output has a GDP per capita of nearly $15,000, up just 0.4% a year from 2010. Colombia's GDP per capita, on the other hand, has increased 3.0% a year, rising from just over $10,000 in 2010 to just over $14,000 in 2020 (Table I-8).

Central America ranges from Panama and its economy from the canal at $27,000 to Honduras and Nicaragua, both around $5,500. The Caribbean countries, on average, enjoy a higher GDP per capita than the Central American countries, with per capita GDP ranging from Puerto Rico and the Bahamas at $34,000 to constantly weather-ravaged Haiti at nearly $3,000 (Table I-8).

Table I-8

South American Country GDP per Capita

Expressed in GDP in PPP Dollars per Person

In 2020 Economic Share Order

					AAGR	
	2010	2015	2020	2025	2010–2020	2021–2025
South America						
Brazil	14,360	14,816	14,916	18,150	0.4%	4.0%
Argentina	18,062	20,105	20,751	25,043	1.4%	3.8%
Colombia	10,664	13,078	14,324	18,525	3.0%	5.3%
Chile	18,952	22,681	23,366	29,248	2.1%	4.6%
Peru	9,533	11,412	11,871	15,972	2.2%	6.1%
Ecuador	9,090	11,015	11,009	12,541	1.9%	2.6%
Venezuela	16,691	17,011	5,178	n/a	-11.0%	n/a
Bolivia	5,235	7,116	8,344	10,524	4.8%	4.8%
Paraguay	9,965	11,358	12,881	16,078	2.6%	4.5%
Uruguay	18,068	21,614	22,459	28,016	2.2%	4.5%
Trinidad & Tobago	30,925	27,397	25,031	30,236	-2.1%	3.9%
Suriname	13,497	15,841	14,513	16,280	0.7%	2.3%
Guyana	8,356	11,205	19,684	50,764	8.9%	20.9%
Central America						
Guatemala	6,511	7,849	8,293	10,017	2.4%	3.9%
Panama	15,074	25,275	27,003	38,202	6.0%	7.2%
Costa Rica	12,930	17,080	19,990	24,455	4.5%	4.1%
El Salvador	6,127	7,598	8,422	10,451	3.2%	4.4%
Honduras	3,778	4,823	5,450	6,649	3.7%	4.1%
Nicaragua	3,987	5,261	5,575	6,423	3.4%	2.9%
Belize	7,555	7,102	6,046	7,113	-2.2%	3.3%

Source: IMF, 2021

Continued

Table I-8 Continued

South American Country GDP per Capita

Expressed in GDP in PPP Dollars per Person

In 2020 Economic Share Order

	2010	2015	2020	2025	AAGR 2010–2020	AAGR 2021–2025
Caribbean						
Dominican Republic	11,671	15,186	18,608	25,227	4.8%	6.3%
Puerto Rico	30,925	34,007	34,025	41,063	1.0%	3.8%
Haiti	2,628	2,903	2,916	3,223	1.0%	2.0%
Jamaica	8,262	9,347	9,975	12,962	1.9%	5.4%
The Bahamas	31,670	34,342	33,148	42,151	0.5%	4.9%
Barbados	16,276	15,571	13,553	18,229	-1.8%	6.1%
Aruba	33,670	35,643	29,090	43,146	-1.5%	8.2%
Antigua & Barbuda	21,426	19,456	18,618	24,420	-1.4%	5.6%
St. Lucia	13,121	13,930	13,359	17,646	0.2%	5.7%
Dominica	10,037	11,242	11,073	14,173	1.0%	5.1%
Grenada	10,863	14,152	15,431	19,269	3.6%	4.5%
St. Kitts & Nevis	21,052	22,563	20,987	27,897	0.0%	5.9%
St. Vincent & the Grenadines	10,029	11,552	12,606	15,943	2.3%	4.8%

Source: IMF, 2021

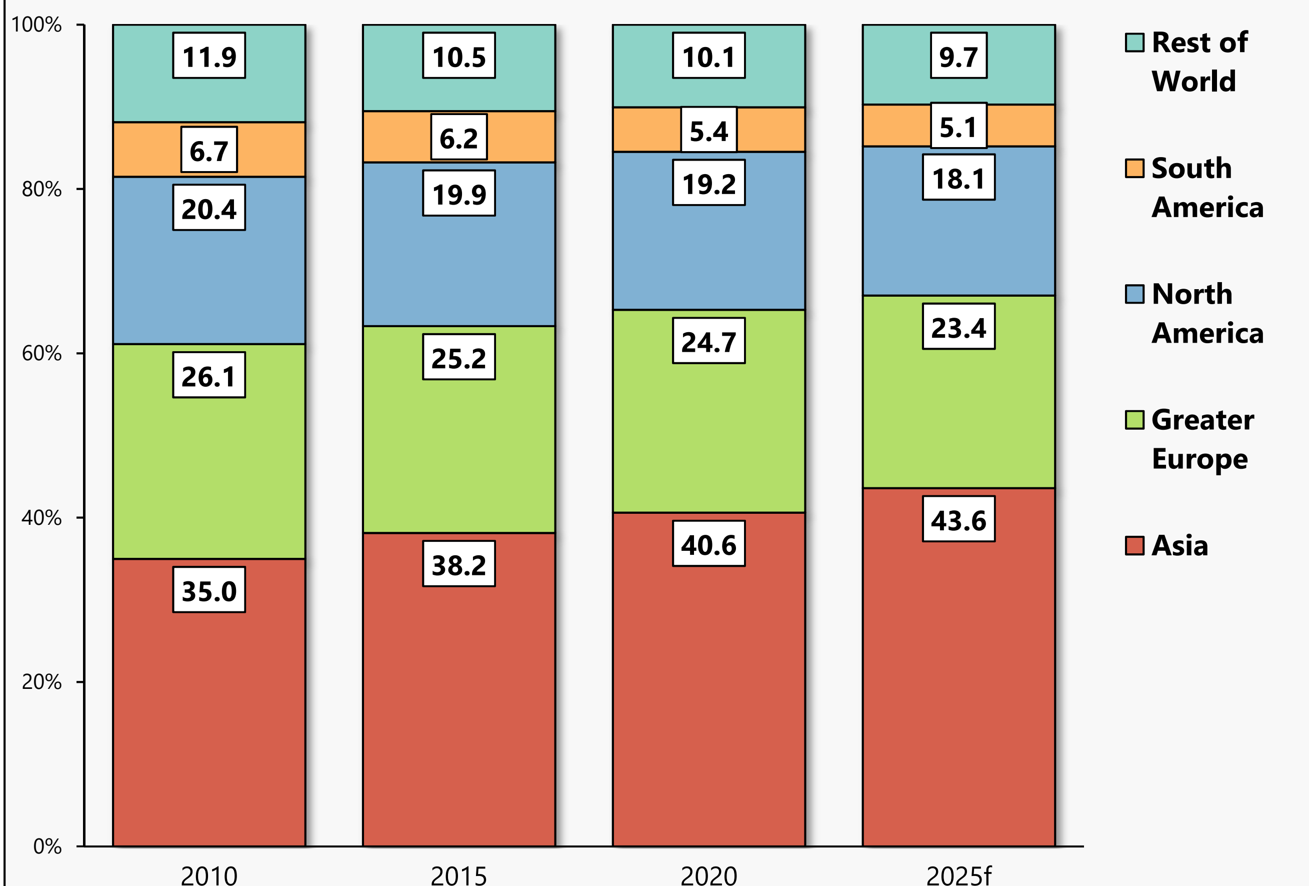
Regional Comparisons

Asia, as defined for this report, is the largest economic region of the five, accounting for 41% of the world's economic output, an increase of 5.6 percentage points from 2010 and 2.4 from 2015. The Greater Europe region accounts for the next largest share at 25%, having declined 1.4 percentage points from 2010 and a decline of 0.5 percentage points from 2015 (Figure I-6).

Figure I-6

Regional Shares of Global Economy, 2010 through 2025

Expressed in percent of World GDP in PPP dollars



Source: IMF and INDA/EDANA Forecasts, 2021

The Americas as an entity would be the same share as Greater Europe (24.7%) of the global economy in 2020. Both regions will decline just over one percentage point each from 2020 to 2025, with the Americas declining 1.5 percentage points and Greater Europe, 1.3 percentage points (Figure I-6).

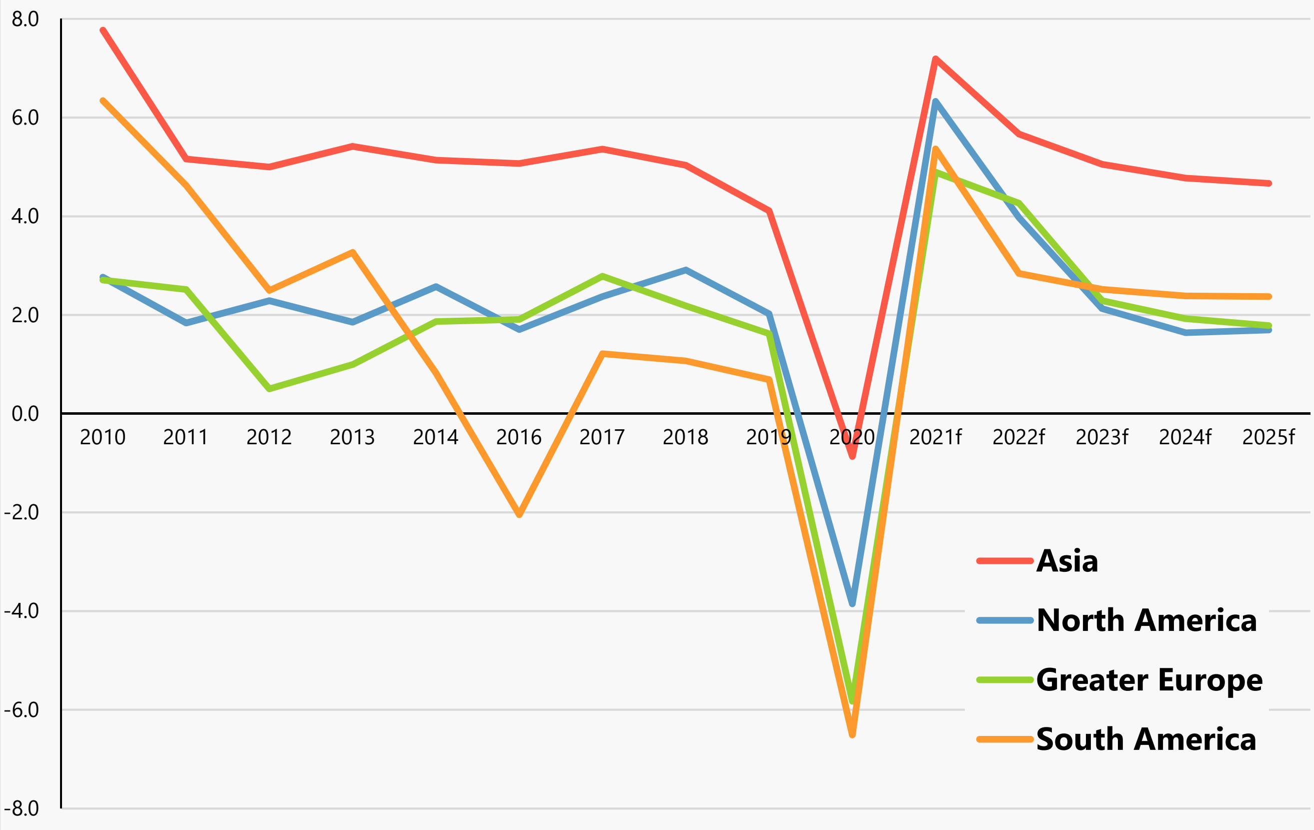
The Rest of the World region includes the region of Middle East and North Africa (MENA), which in 2020 accounted for 5.7% of the world's economy; Central and South Africa, which accounted for 3.2%; and the advanced economies of Australia and New Zealand which accounted for 1.2%.

Through the forecast period Asia will experience the strongest growth of the regions, averaging 5.5% annually through the forecast period, followed by Noth America at 3.2%, South America at 3.1%, and Greater Europe at 3.0% (Figure I-7).

Figure I-7

Annual Growth of Real GDP by Region, 2010-2025

Percent Change From Preceding Period



Source: IMF and INDA/EDANA Estimates, 2021

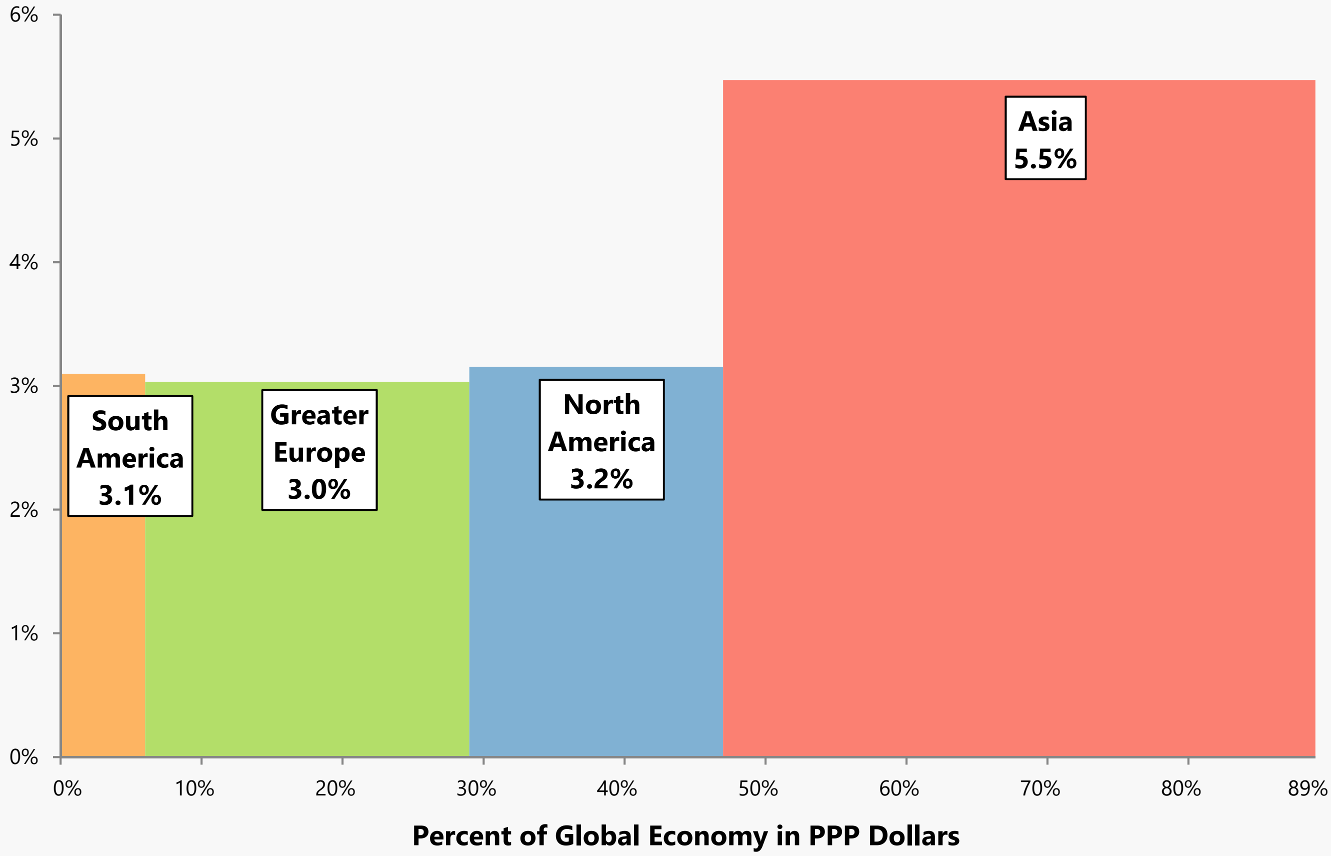
Figure I-7 displays each of the global region's historical growth (2010–2020) and projected economic growth (2021–2025). The figure clearly exhibits, in addition to the impact of the pandemic, the relative steady growth of the regions—with the exception of South America—between 2011 and 2019, then a revert to those averages in the 2023–2025 period (Figure I-7).

Over the next five years, the majority of the global growth will occur in Asia. This is clearly illustrated in Figure I-8 which highlights the magnitude of the economic forecast from 2021 through 2025 and the sheer economic size (the size of the box) of the Asian region compared to the other regions (Figure I-8).

Figure I-8

Regional GDP Forecast by Share of Global Economy

Real GDP Forecast Annual Average 2021-2025



Source: IMF and INDA/EDANA Estimates, 2021

As a result, by 2025 Asia's economic share of the global economy will rise to 44%, an increase of 2.9 percentage points from 2020. The other three regions will decline in share, led by Greater Europe, declining 1.3 percentage points and North America 1.1 points. (Figure I-6).

POPULATION

Certain demographic trends—births and aging—drive demand in the nonwovens market and are a key building block of the global nonwovens demand forecasts. The relationship between nonwovens and population impacts more than just the absorbent hygiene market; as the elderly age, the medical/surgical market grows, and as families start, the home and office furnishings market increases, as does the building construction market.

Through the forecast period (2021–2025), three demographic trends play a role in the population forecasts:

- global population growth is slowing, as is the absolute number of babies born;
- the increasing total population of the elderly; and
- the rising level of GDP per capita globally.

Population growth is driven by four different factors: mortality, fertility, migration, and population momentum. The total fertility rate (sometimes also called the fertility rate, absolute/potential natality, period total fertility rate, or total period fertility rate of a population) is the average number of children that would be born to a woman over her lifetime. The fertility rate of the world was at 5 children per woman until the mid-1960s. Since then the fertility rate has halved and is today below 2.5 children per woman. And over the course of the modernization of societies, the number of children per woman decreases very substantially. As health is rapidly improving around the world, life expectancy is also increasing rapidly, while the child mortality rate is declining. Population momentum has to do with the age structure of the population. Population momentum allows a youthful population with constant levels of mortality and a net migration of zero to grow even when fertility remains constant at the replacement level. In this situation, a relatively youthful age structure promotes a more rapid growth because the births being produced by the relatively large number of women of reproductive age outnumber the deaths occurring in the total population, even if the fertility of the average woman stands at the replacement level.

Currently, the world population continues to grow, albeit more slowly than in the recent past. The global population growth rate peaked in 1962 and has been declining ever since, as world population growth has halved. In the 1980s global population grew 1.8% annually and has dropped to 1.2% annually in the 2010s (Table I-9).

Table I-9

Population Growth by Decade

	Annual Growth Rate	Average Growth per Year
1980–1989	1.81%	85.4 million
1990–1999	1.45%	82.4 million
2000–2009	1.26%	80.7 million
2010–2019	1.16%	84.0 million

Source: IMF, 2021

In the last ten years (2011-2020) the global growth rate was 1.13%, adding an average 80.5 million people annually. In the last five years, population growth has further slowed, growing at annual rate of 1.08% in the last five years, when 80.4 million people were added annually, adding an additional 400 million people.

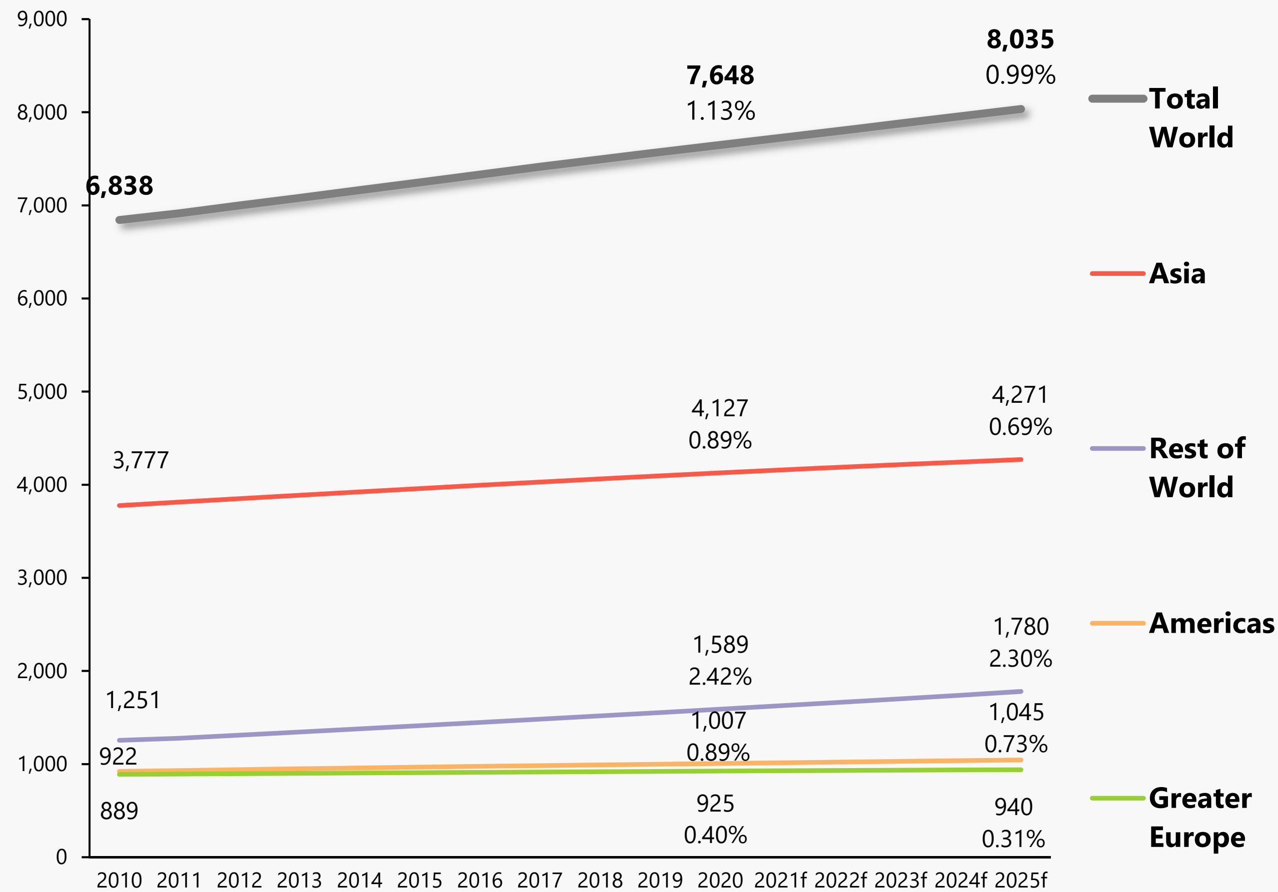
The world population is forecast to significantly slow through the forecast period (2021–2025) expanding only 0.99% percent a year, adding 77.3 million people annually. While this may not seem significant, through the five-year forecast period an additional 386 million people are added, 16 million less than the previous five-year period. This compares to only a decline of 1.4 million people in the previous five-year period (2016–2020).

The figure below (Figure I-9) groups the global population into four major regions as defined in the Economic Growth section: Asia, the Americas, Greater Europe and the Rest of the World. Globally Asia accounted for 54% of the population in 2020 (4.127 million people) followed by the Rest of the World at 14%, the Americas at 13% and Greater Europe 12%. In terms of population, the Americas and Greater Europe account for 25% of the global population, yet accounted for 48% of the global nonwovens production in 2020.

Figure I-9

Global Annual Growth of Population, 2010-2025

Annual, Persons in Millions, Followed by 10-Year Historical and 5-Year Forecast AAGR



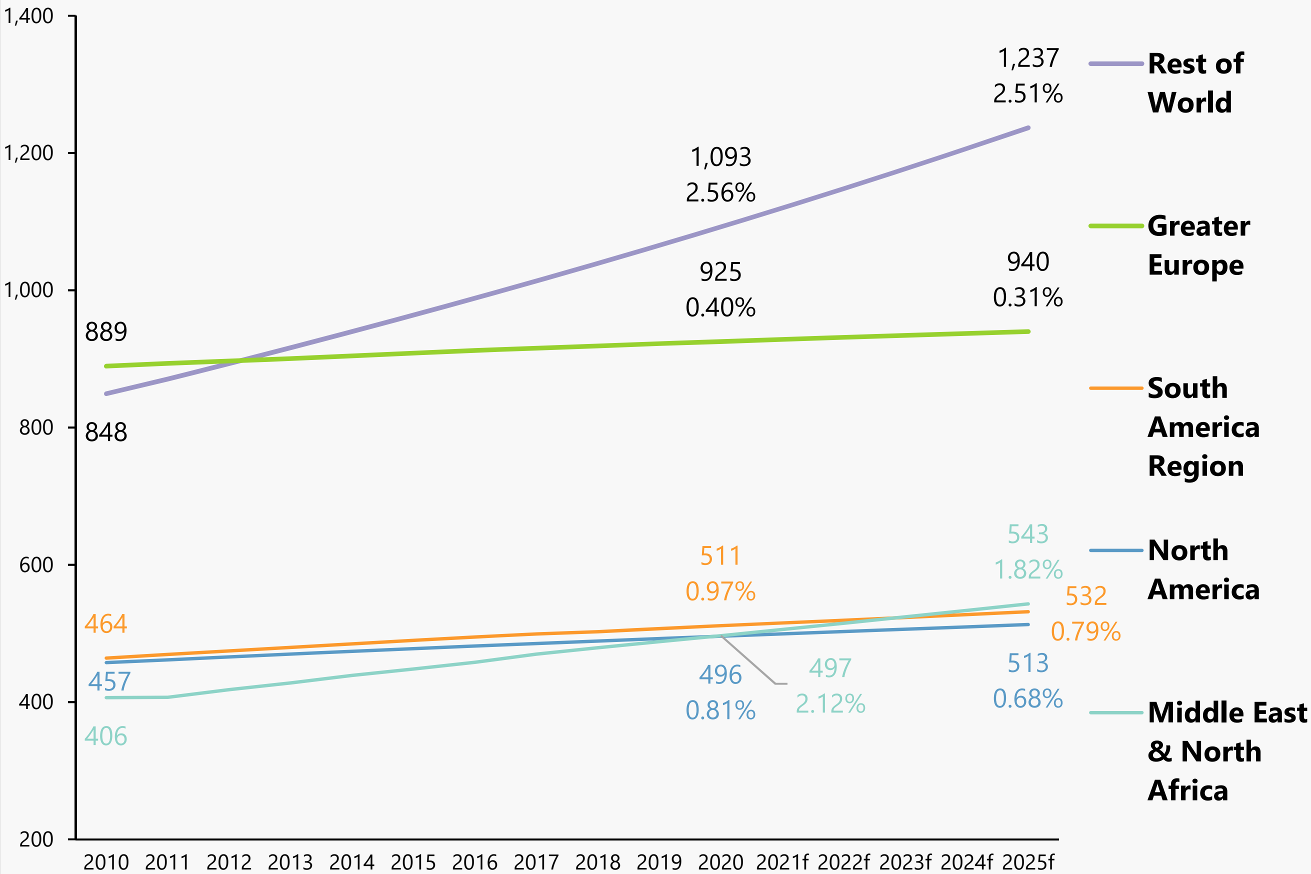
Source: IMF, 2021

Removing Asia from the figure above (Figure I-9), the significant growth of the Rest of the World is noteworthy. Also noteworthy, through the forecast period (2021–2025), the total population in the Middle East & North Africa region passes that of South America region and continues to further the distance and growth from that of North America (Figure 1-10).

Figure I-10

Select Regions Annual Growth of Population, 2010-2025

Annual, Persons in Millions, Followed by 10-Year Historical and 5-Year Forecast AAGR



Source: IMF, 2021

The global population is getting older. A key demographic change occurred in 2018 when the number of people aged 65 years and older surpassed the number of children under 5 years old. This was the first time in history this was the case. As fertility declines and life expectancy rises, the proportion of the population above a certain age rises. This phenomenon, known as population aging, is occurring throughout the world. Global life expectancy grew by 6 years between 2009 and 2019 (the last year data is available). On average, a child born in 2019 can expect to live 72.6 years, up from 66.6 in 2009.

As a result of population aging, in 2016 the world's advanced economics reached a critical milestone. For the first time since 1950, their combined working-age (15–64 years of age) population will decline. The ranks of workers will also fall in key emerging markets, such as China and Russia. Why is that important for businesses? In recent decades, as China and other developing countries joined the global market economy, billions of people entered the global workforce. With labor in broad supply, inequality rose in richer countries, as wages for low-skilled workers were held down by overseas competition. But now, the process will soon be going into reverse. As the working-age population falls, the labor excess will ease. And as low-skill labor becomes comparatively rare, eventually its price will rise. As the price of labor rises, so will GDP per capita. GDP per capita is often linked by economists with standard of living; as GDP per capita rises, consumers have discretionary spending money, of which some is spent for the purchase of goods containing nonwoven material.

The following regional population forecasts are based on assumptions about future births, deaths, net international migration, and domestic migration. There are three demographic reasons why populations change: people are born, they die, and they move into or out of a country. Together, the number of births, deaths, and net international migrants make up the total population change over a period of time.

North America

The North America region is comprised of Canada, Mexico and the United States of America. Within North America, the United States is the dominant country economically and in population, accounting for 88.5% of the region's real GDP in 2020 and 66.6% of the population. Mexico, while third in the share of economic output (4.5%) accounts for 25.8% of the region's population. Canada accounts for 7.7% of the region's economic activity and 7.4% of the population (Table I-10).

Table I-10

Country Share of North American Population

Percent of Population, AAGR based on Actual Population

	2010	2020	2025
North America			
United States	67.7%	66.6%	66.2%
Mexico	24.9%	25.8%	26.0%
Canada	7.4%	7.7%	7.8%
Total Population, Millions	**457.439**	**495.851**	**512.939**

Source: IMF, 2021

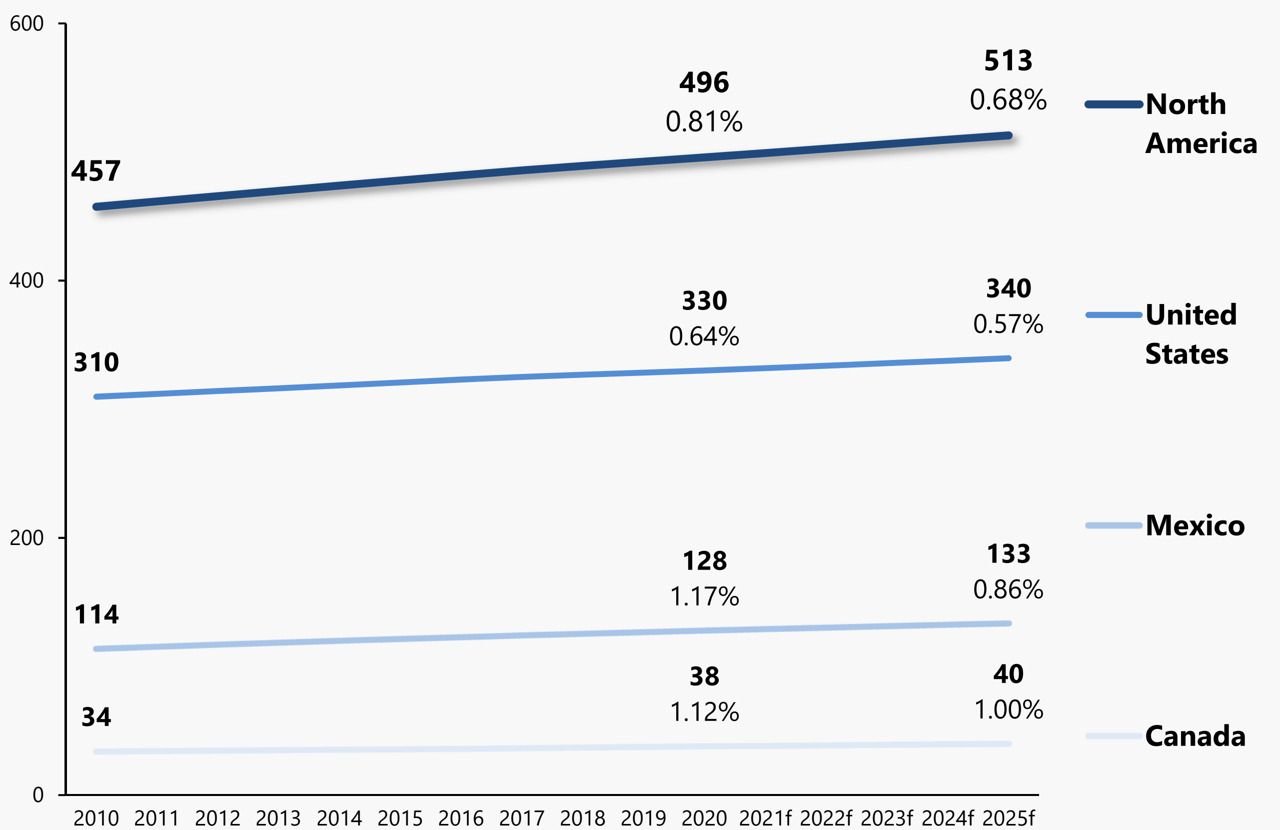
North American population growth has been gradually slowing over the last 29 years and is forecast to continue slowing through the forecast period. Millennials will begin starting families in the United States, causing a rise in births, while Mexico will experience a decrease in birth rates with the growing economic and social development in the country. In Mexico, population growth has slowed during the past 10 years as young people increasingly prioritize work over starting a family and consequently have fewer children on average than their parents and grandparents. In the United States, immigration is projected to be a driver of population growth, but it is important to note that possible future changes in immigration policy or other events could substantially alter the projected totals.

Figure I-11

Annual Growth of Population in North America, 2010-2025

Includes: Canada, Mexico and United States

Annual, Persons in Millions, Followed by 10-Year Historical and 5-Year Forecast AAGR



Source: IMF, 2021

Overall, the population of North America (Canada, Mexico and the United States) is expected to average 0.68% annual growth through the forecast period (2021–2025), adding an additional 17.1 million people. This compares to an annual growth of 0.74% in the previous five years when a total of 18.0 million people were added, and a rate of 0.81% in the previous ten years (Figure I-11).

The United States population growth reached an 80-year low (0.67%) in 2020, a result of declines in the number of births, gains in the number of deaths, declines in immigration. Life expectancy in the United States fell by a year and a half in 2020 to 77.3 years, the lowest level since 2003, primarily due to the deaths caused by the COVID-19 pandemic. Life expectancy has been increasing gradually every year for the past several decades. Recently, however, slight declines in life expectancy have occurred since 2014 reflecting increases in most major causes of death, in addition to opioid deaths, which occur at relatively young ages. Ultimately, however, the aging American population is the broader cause, a factor that the nation will have to cope with for years and decades to come. As the country ages, it transitions towards a much older population structure, resulting in a decrease in the proportion of the working age while the number of the retired population increases. This will cause a high burden on the working age population as they provide for the increasing number of the older population.

North America contains the third (United States) and tenth (Mexico) largest countries in the world. Canada is the thirty-ninth largest. North American population accounted for 6.5% of the world's population in 2020 and 20.4% of the global economic output. The regions share is forecast to drop to 6.4% by the end of 2025 (Tables I-10 and I-11).

Table I-11

North American Share of Global Population

Percent of Population, AAGR based on Total Population Growth

				AAGR	
	2010	**2020**	**2025**	**2010–2020**	**2021–2025**
North America					
United States	4.5%	4.3%	4.2%	0.6%	0.6%
Mexico	1.7%	1.7%	1.7%	1.2%	0.9%
Canada	0.5%	0.5%	0.5%	1.1%	1.0%
Total	**6.7%**	**6.5%**	**6.4%**	**0.8%**	**0.7%**

Source: IMF, 2021

Greater Europe

The Greater Europe region includes all the countries of Western, Central and Eastern Europe, 51 countries in total. Western Europe accounted for 86.8% of the region's real GDP and 46.4% of the population in 2020. The CIS countries accounted for 9.4% of the economic output and 31.5% of the population. While the Central European countries accounted for 3.8% of the region's real GDP and 22.1% of the population (Table I-12).

Table I-12

Country Share of Greater European Population

Percent of Population, AAGR based on Actual Population

	2010	2020	2025
Western Europe			
Germany	9.0%	9.0%	8.9%
United Kingdom	7.1%	7.3%	7.3%
France	7.1%	7.0%	7.0%
Italy	6.7%	6.5%	6.4%
Spain	5.2%	5.1%	5.1%
Remaining Countries	11.4%	11.5%	11.6%
Total	**46.5%**	**46.4%**	**46.3%**
Central Europe			
Turkey	8.3%	9.1%	9.5%
Poland	4.3%	4.1%	4.0%
Romania	2.3%	2.1%	2.1%
Czech Republic	1.2%	1.2%	1.1%
Remaining Countries	6.1%	5.6%	5.5%
Total	**22.1%**	**22.1%**	**22.2%**
C.I.S.			
Russia	16.1%	15.9%	15.5%
Ukraine	5.1%	4.5%	4.3%
Uzbekistan	3.1%	3.7%	3.9%
Kazakhstan	1.8%	2.0%	2.1%
Remaining Countries	5.2%	5.4%	5.6%
Total	**31.4%**	**31.5%**	**31.5%**
Total Population, Millions	**889.419**	**925.197**	**939.807**

Source: IMF, 2021

As with its economic development, Greater Europe is very heterogeneous in regards to its population growth, birth rates and life expectancy with considerable divergence within the region.

As a whole, though, Greater European population growth has been moderate over the last 10 years expanding 0.40% annually; however, there was a significant range of growth rates, with five countries (Kyrgyz Republic, Luxembourg, Malta, Tajikistan, and Uzbekistan) all having average annual growth rates over 1.5% and 18 countries contracting, including Greece, Poland, and Portugal.

The picture is somewhat similar in the forecast period with growth rates ranging from 2.1% (Kyrgyz Republic) to –1.8% (Moldova). Within the region the annual growth rates slow in Western Europe (0.38% average annual growth rate in the previous ten years and 0.26% average annual growth through the forecast) and the Commonwealth of Independent States (0.44% to 0.32%) and increase in Central Europe (0.36% to 0.42%). If Turkey was not included in Central Europe, the growth rate for Central Europe would be negative in the historical period and through the forecast period, declining 0.10% annually.

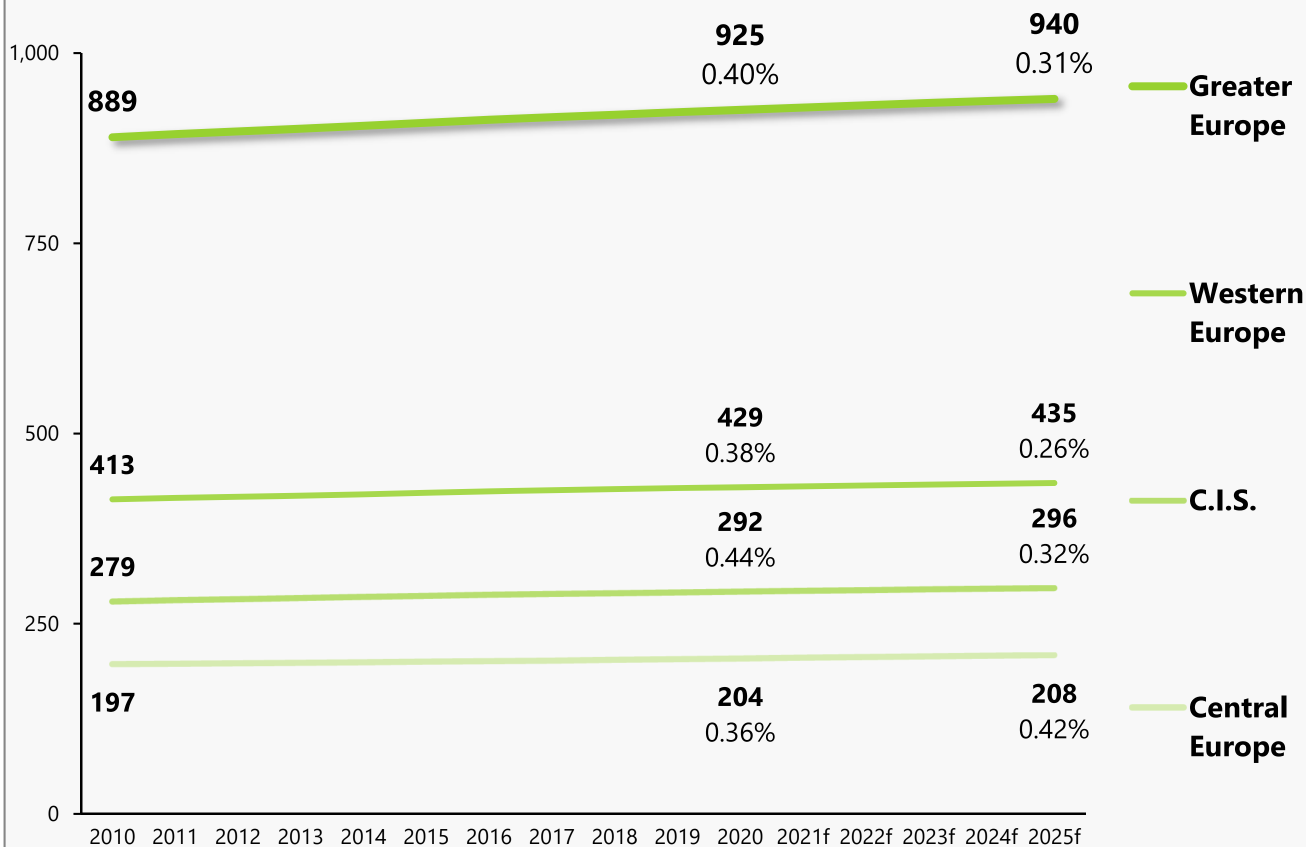
Overall, in Greater Europe the population is forecast to grow 0.31% annually, reaching a population of nearly a billion (940 million) people. In the five-year forecast period overall population is forecast to increase by 14.6 million, compared to 16.8 million in the previous five-year period (Figure I-12 and Table I-13). Interestingly, North America is forecast to add more people in the forecast period (17.1 million) compared to Greater Europe (14.6 million).

Five countries account for more than three-quarters (79%) of the absolute population increase: Turkey, itself accounts for a third (4.959 million people); Uzbekistan 20% (2.981 million), the United Kingdom 10% (1.414 million), Kazakhstan 9% (1.242 million), and France 6% (0.912 million). Eighteen of the 51 countries in Greater Europe are forecast to experience net population loss, the three largest countries of the fifteen being the Ukraine (–0.823 million), Russia (–0.807 million), and Belarus (–0.233 million), all in the C.I.S. region.

Figure I-12

Annual Growth of Population in Greater Europe, 2010-2025

Includes: 51 Countries in Western, Central and Eastern Europe, including C.I.S. and Turkey
Annual, Persons in Millions, Followed by 10-Year Historical and 5-Year Forecast AAGR



Source: IMF, 2021

Western Europe is also experiencing a similar demographic phenomenon as the United States, that is the aging of Europe. Like the United States, fertility rates are declining in Western Europe; however, unlike the Unite States, with the exception of COVID-19, there has been a decrease in mortality rate, and a higher life expectancy among European populations.

Greater Europe contains six of the twenty-five largest countries in the world: Russia (9th), Turkey (17th), Germany (19th), the United Kingdom (21st), France (22nd), and Italy (23rd). Greater European population accounted for 12.1% of the world's population in 2020 and is forecast to drop to 11.7% by the end of 2025, as all of the sub-regions lose share (Table I-13).

Table I-13

Greater European Share of Global Population

Percent of Population, AAGR based on Total Population Growth

				AAGR	
	2010	**2020**	**2025**	**2010–2020**	**2021–2025**
Western Europe					
Germany	1.2%	1.1%	1.0%	0.4%	0.1%
United Kingdom	0.9%	0.9%	0.9%	0.7%	0.4%
France	0.9%	0.9%	0.8%	0.4%	0.3%
Italy	0.9%	0.8%	0.7%	0.1%	-0.1%
Spain	0.7%	0.6%	0.6%	0.1%	0.3%
Remaining Countries	1.5%	1.4%	1.4%	0.5%	0.4%
Total	**6.0%**	**5.6%**	**5.4%**	**0.4%**	**0.3%**
Central Europe					
Turkey	1.1%	1.1%	1.1%	1.3%	1.2%
Poland	0.6%	0.5%	0.5%	0.0%	-0.1%
Romania	0.3%	0.3%	0.2%	-0.5%	0.0%
Czech Republic	0.2%	0.1%	0.1%	0.2%	0.2%
Remaining Countries	0.8%	0.7%	0.6%	-0.4%	-0.2%
Total	**2.9%**	**2.7%**	**2.6%**	**0.4%**	**0.4%**
CIS					
Russia	2.1%	1.9%	1.8%	0.3%	-0.1%
Ukraine	0.7%	0.5%	0.5%	-0.9%	-0.4%
Uzbekistan	0.4%	0.4%	0.5%	1.9%	1.7%
Kazakhstan	0.2%	0.2%	0.3%	1.4%	1.3%
Remaining Countries	0.7%	0.7%	0.7%	0.9%	0.8%
Total	**4.1%**	**3.8%**	**3.7%**	**0.4%**	**0.3%**
Total	**13.0%**	**12.1%**	**11.7%**	**0.4%**	**0.3%**

Source: IMF, 2021

Asia

Asia—for the purpose of this report—is defined as a 37-country region including Asia, South East Asia and the Pacific Islands. China is the largest in population, accounting for 34% of the region's population and is by far the dominant economy in the region accounting for 51% of the region's economic activity. The second largest country in terms of population is India at 33.4%, yet it only accounts for 9% of the region's economic output.

The third most populous country in the region is Indonesia, accounting for 6.5% of the region's population and 4% of the economic activity (Table I-14).

Table I-14

Country Share of Asian Population

Percent of Population, AAGR based on Actual Population

	2010	2020	2025
Advanced Economies			
Japan	3.4%	3.0%	2.9%
Korea	1.3%	1.3%	1.2%
Taiwan Province of China	0.6%	0.6%	0.6%
Hong Kong SAR	0.2%	0.2%	0.2%
Singapore	0.1%	0.1%	0.1%
Total	**5.6%**	**5.2%**	**5.0%**
ASEAN			
Indonesia	6.3%	6.5%	6.6%
Philippines	2.5%	2.6%	2.7%
Vietnam	2.3%	2.4%	2.4%
Remaining Countries	2.6%	2.7%	2.7%
Total	**13.7%**	**14.2%**	**14.4%**
Other Asia			
China	35.5%	34.0%	33.2%
India	32.7%	33.4%	33.8%
Pakistan	4.5%	5.1%	5.4%
Bangladesh	3.9%	4.0%	4.0%
Thailand	1.8%	1.7%	1.6%
Remaining Countries	2.3%	2.4%	2.6%
Total	**80.7%**	**80.6%**	**80.6%**
Total Population, Millions	**3,776.784**	**4,127.073**	**4,270.538**

Source: IMF, 2021

The population growth rate for the advanced economies in Asia (Japan, Korea, Taiwan, Hong Kong, and Singapore) was slightly positive through the ten-year historical period, 0.09%, and is forecast to decline 0.18% annually through the forecast period. In the ten-year historical period, this region added only 196 thousand people a year to the advanced economies. With population declining in the forecast period, the advanced economic Asian countries will decline by 1.958 million, comparable to the number added in the previous ten years. Of the advanced economies in Asia, Japan is forecast to be the only country to lose population, 2.7 million people through the forecast period, with population growth declining 0.44% annually, compared to the previous ten year annual average of –0.14%, population momentum in action. Japan is actually the only country in the region with a negative growth forecast.

The rest of Asia, though, is forecast to continue its strong population growth; however, the forecast growth rate is slower than that of the historical growth rate. The total Asian growth rate expanded in the previous ten years at a 0.89% annual rate; excluding the advanced economies, the growth would have been 0.94% annually. In the forecast period, Asia's population is forecast to expand 0.69% annually, adding an additional 143.5 million through the forecast period, compared to 168.5 million in the previous five year period (Figure I-13 and Table I-15).

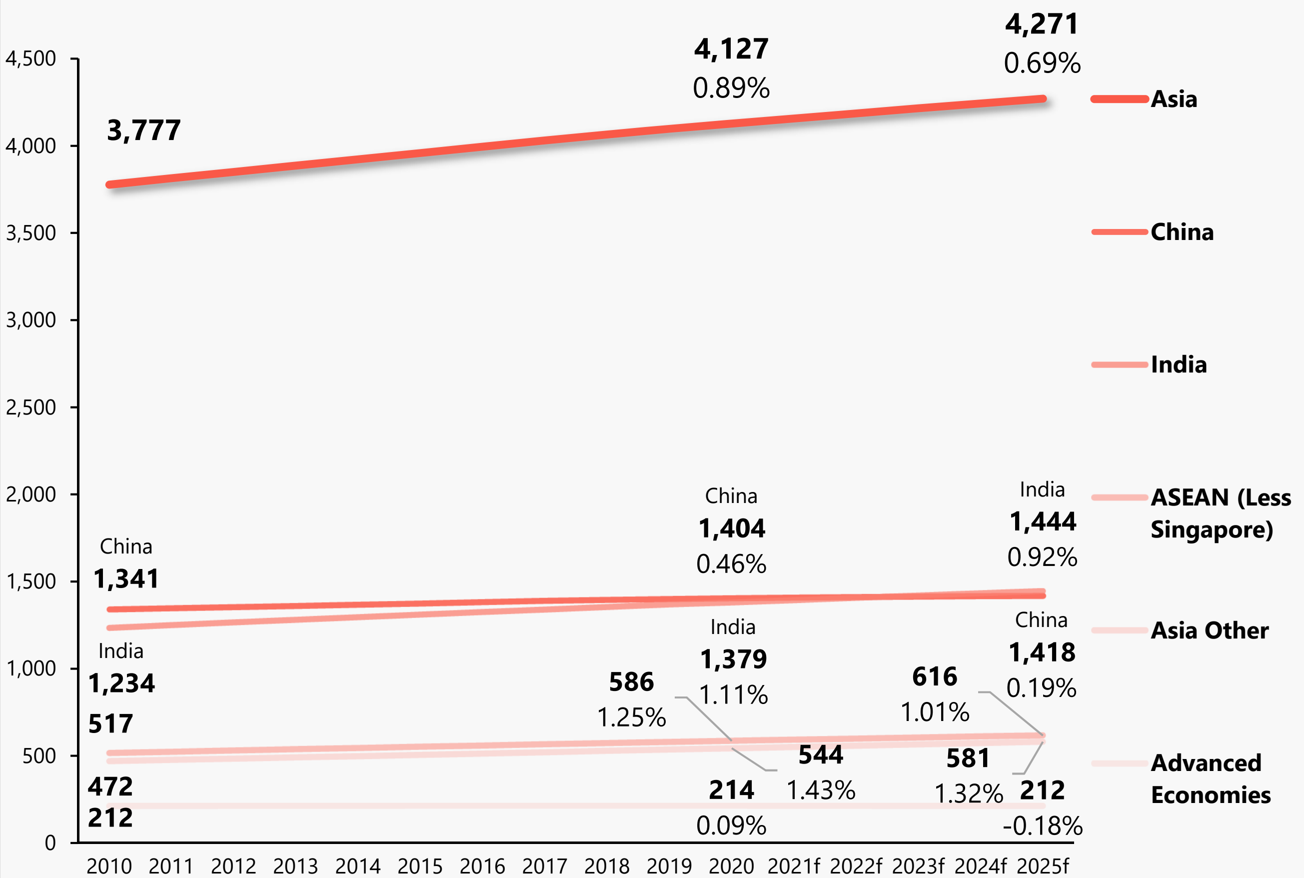
At the end of the forecast period, it is predicated the total population of India will surpass that of China (1.443 billion in India and 1.418 billion in China). However, GDP per capita will still be significantly lower, with India just passing US$10,000 and China surpassing US$25,000 (Table I-6). In the last ten years, India's average annual growth rate was double that of China's (1.11%, compared to China's 0.46%). India's rate of growth is not forecast to slow significantly from 2021 through 2025 (.92%), while China's is halved (0.19%) (Figure I-13 and Table I-15). For years China's ruling Communist Party implemented a series of policies intended to slow the growth of the world's most populous nation, including limiting the number of children couples could have to one. The long term effects of those policies mean the country will soon enter an era of "negative growth," or a contraction in the size of the total population, though this is not forecast to occur until 2027. The government has recognized the worrisome demographic trend and in 2013 began easing enforcement of the "one child" policy in certain circumstances. It then raised the limit to two children for all families in 2016, in hopes of encouraging a baby boom. It did not work. After a brief uptick that year (the birth rate went from 12.07 in 2015 to 12.95 in 2016), the birth rate (12.43) and number of births fell again in 2017, with 17.23 million babies born compared to 17.86 in 2016, and has continued to decline. According to preliminary data, around 12 million babies were born in China in 2020, the lowest since China relaxed its one-child policy. It also marks the lowest official birth rate in China since 1961, however; there are widely held concerns about the historical data collection. In recent years, many Chinese couples have been reluctant to have children due to the rising cost of health care, education and housing, not to mention the economic uncertainties brought on by COVID-19.

Figure I-13

Annual Growth of Population in Asia, 2010-2025

Includes: 37 Countries in Asia

Annual, Persons in Millions, Followed by 10-Year Historical and 5-Year Forecast AAGR



Source: IMF, 2021

As in other countries, there are myriad reasons for the declining birth rate, including rising prosperity and new opportunities for women. China's economic expansion has created a society where many young couples now struggle with economic pressures—including rising education and housing costs—making it difficult to have even one child, let alone two. China's rapidly aging population will create policy headwinds for Chinese leaders as they promise to guarantee health care and pension payments, despite an expected shrinking of the labor force and challenges to lifting China's slowing labor productivity. Many compare China's demographic crisis to the one that stalled Japan's economic boom in the 1990s.

Growth rates are also slow in the Association of Southeast Asian Nations (ASEAN)—less

Singapore, which is included in the Advanced Economies—and the Rest of Asia, primarily Thailand, Pakistan, and Bangladesh (Figure I-13 and Table I-15).

Five countries will account for the majority (83%) of the population growth through the forecast period (2021–2025), with India accounting for just less than half (45%) of the population increase. India will add another 64.9 million people, Pakistan 20.3 million (14% of the region's population increase), China 13.6 million (9.5%), Indonesia 12.3 million (8.5%) and the Philippines 8.6 million (6%).

Table I-15

Asian Share of Global Population

Percent of Population, AAGR based on Total Population Growth

				AAGR	
	2010	**2020**	**2025**	**2010–2020**	**2021–2025**
Advanced Economies					
Japan	1.9%	1.6%	1.5%	-0.1%	-0.4%
Korea	0.7%	0.7%	0.6%	0.4%	0.1%
Taiwan Province of China	0.3%	0.3%	0.3%	0.2%	0.1%
Hong Kong SAR	0.1%	0.1%	0.1%	0.6%	0.6%
Singapore	0.1%	0.1%	0.1%	1.3%	1.2%
Total	**3.1%**	**2.8%**	**2.6%**	**0.1%**	**-0.2%**
ASEAN					
Indonesia	3.5%	3.5%	3.5%	1.3%	0.9%
Philippines	1.4%	1.4%	1.5%	1.6%	1.5%
Vietnam	1.3%	1.3%	1.3%	1.0%	0.9%
Remaining Countries	1.4%	1.4%	1.4%	1.1%	0.9%
Total	**7.6%**	**7.7%**	**7.7%**	**1.3%**	**1.0%**
Other Asia					
China	19.6%	18.4%	17.6%	0.5%	0.2%
India	18.0%	18.0%	18.0%	1.1%	0.9%
Pakistan	2.5%	2.7%	2.8%	2.0%	1.9%
Bangladesh	2.2%	2.2%	2.2%	1.1%	0.9%
Thailand	1.0%	0.9%	0.9%	0.4%	0.2%
Remaining Countries	1.2%	1.3%	1.4%	1.7%	1.6%
Total	**44.6%**	**43.5%**	**42.8%**	**0.9%**	**0.7%**
Total	**55.2%**	**54.0%**	**53.2%**	**0.9%**	**0.7%**

Source: IMF, 2021

The Asia region includes five (China, India, Indonesia, Pakistan, and Bangladesh) of the ten largest countries in the world, accounting for just less than half (45%) of the world's population.

Even though Asia as a whole is experiencing robust annual population growth rates, due to significant population growth in Africa, Asia actually loses share of the overall global population, dropping from a share of 54.0% in 2020 to 53.2% in 2025, though some countries in Asia do gain share through the forecast period, most notably Pakistan (Table I-15).

South America

The South America region includes the continent of South America in addition to the countries in Central America and the Caribbean. By far the most populous country in the region is Brazil, topping 200 million (211.4 million) in 2020 and accounting for approximately 41% of the South American region's population and 50% of the region's economic output (Table I-16). Brazil is also the fifth most populous country on earth and the only South American country in the twenty largest countries. Only five of the South America region countries are in the top fifty largest countries: in addition to Brazil, Columbia is the 29th largest, Argentina 32nd, Peru 43nd, and surprisingly, Venezuela at 50th (Venezuela was 43rd in 2010).

Similar to other emerging economies, many countries in South America are experiencing a drop in fertility rates, with the growth in economic and social development, urbanization, industrialization, and the expansion of the educational system. Urbanization and development correlate with reduced birth rates. Changes in fertility in South America have occurred with the expansion of mandatory education, which simultaneously has raised the cost of rearing children, reduced benefits to families, and provided young women with the education needed to seek employment. This has resulted in a decline in the population growth rate, from 1.89% in the 1990s to 1.28% in the 2000s, to 0.97% in the 2010s. The population growth rate is forecast to continue declining through the forecast period to 0.79%, adding another 20.4 million people (Figure I-14).

Table I-16

Country Share of South America Population

Percent of Population, AAGR based on Actual Population

	2010	2020	2025
South America			
Brazil	42.0%	41.4%	40.9%
Colombia	9.8%	10.0%	10.0%
Argentina	8.8%	8.9%	9.0%
Peru	6.3%	6.6%	6.6%
Venezuela	6.1%	5.5%	5.1%
Chile	3.7%	3.8%	3.9%
Remaining Countries	8.0%	8.4%	8.6%
Total	**84.8%**	**84.4%**	**84.0%**
Central America			
Guatemala	3.2%	3.5%	3.7%
Honduras	1.8%	1.9%	2.0%
Remaining Countries	4.4%	4.5%	4.5%
Total	**9.4%**	**9.9%**	**10.3%**
Caribbean			
Haiti	2.1%	2.2%	2.3%
Dominican Republic	2.0%	2.0%	2.1%
Remaining Countries	1.7%	1.4%	1.4%
Total	**5.9%**	**5.7%**	**5.7%**
Total Population, Millions	**464.090**	**511.297**	**531.699**

Source: IMF, 2021

While the growth rates are declining, the region is still experiencing a demographic dividend, that is the population aged between 15 and 64 is growing faster than the population younger than 15 and older than 64. The demographic dividend provides a boost in economic productivity that occurs when there are growing numbers of people in the workforce relative to the number of dependents, as more people have the potential to be productive and contribute to growth of the economy. All else being equal, per capita income grows more rapidly during this time too.

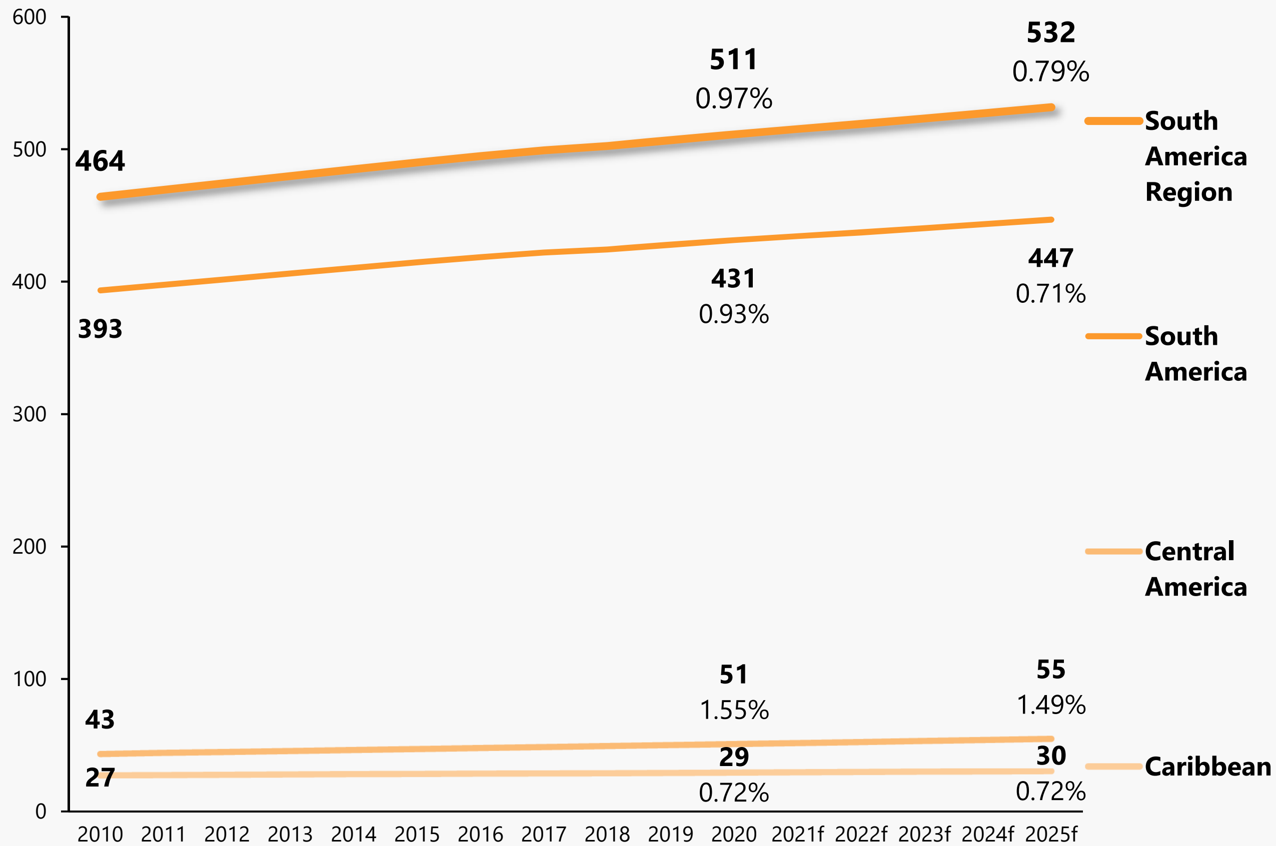
Continental South America, which accounts for 84% of the region's population, slows more precipitously than the other two sub-regions, slowing from 0.93% annually in the historical period (2010–2020) to 0.71% annually through the forecast period (2021–2025).

The Caribbean region maintains the same rate, 0.72%. The Central American region, led by Guatemala, maintains the strongest growth of the three, only slowing from 1.55% annually to 1.49% through the forecast period (Figure I-14 and Table I-17).

Figure I-14

Annual Growth of Population in South America, 2010-2025

Includes: 33 Countires in the Caribbean, Central America and South America
Annual, Persons in Millions, Followed by 10-Year Historical and 5-Year Forecast AAGR



Source: IMF, 2021

Through the historical period (2010–2020) the three highest growth rate countries were in Central America: Belize (2.67%), Guatemala (2.08%), and Honduras (1.80%). Rounding out the top five were Bolivia (1.69%) and Panama (1.57%). The three slowest growth countries were Puerto Rico (–1.62%), Venezuela (–0.2%), and Jamaica (0.15%). This slow growth has been more of a recent phenomenon for St. Vincent and the Grenadines (0.18%), and Barbados (0.28%). In the last five years, Puerto Rico and Venezuela, have been added to the list of countries with slow growth since in the last five years their average annual growth rates have been –1.86% and –1.81% (Table I-17).

Through the forecast period the same three Central American countries are forecast to be the three fastest growth countries in the region, with Bolivia and Ecuador rounding out the top five.

Outside of continental South America, the most populous countries in Central America and the Caribbean tend to have the highest population growth rates, while continental South America is the most populous. Through the forecast period, the South American region's share of the global population declines slightly from 6.7% to 6.6% (Table I-17).

Table I-17

South American Share of Global Population

Percent of Population, AAGR based on Total Population Growth

	2010	2020	2025	AAGR 2010–2020	AAGR 2021–2025
South America					
Brazil	2.8%	2.8%	2.7%	0.8%	0.6%
Colombia	0.7%	0.7%	0.7%	1.1%	0.9%
Argentina	0.6%	0.6%	0.6%	1.1%	1.0%
Peru	0.4%	0.4%	0.4%	1.3%	1.0%
Venezuela	0.4%	0.4%	0.3%	-0.2%	-0.8%
Chile	0.2%	0.3%	0.3%	1.3%	1.0%
Remaining Countries	0.5%	0.6%	0.6%	1.4%	1.3%
Total	**5.8%**	**5.6%**	**5.6%**	**0.9%**	**0.7%**
Central America					
Guatemala	0.2%	0.2%	0.2%	2.1%	2.0%
Honduras	0.1%	0.1%	0.1%	1.8%	1.8%
Remaining Countries	0.3%	0.3%	0.3%	1.1%	0.9%
Total	**0.6%**	**0.7%**	**0.7%**	**1.6%**	**1.5%**
Caribbean					
Haiti	0.1%	0.1%	0.2%	1.4%	1.2%
Dominican Republic	0.1%	0.1%	0.1%	1.0%	0.9%
Remaining Countries	0.1%	0.1%	0.1%	-0.5%	-0.3%
Total	**0.4%**	**0.4%**	**0.4%**	**0.7%**	**0.7%**
Total	**6.8%**	**6.7%**	**6.6%**	**1.0%**	**0.8%**

Source: IMF, 2021

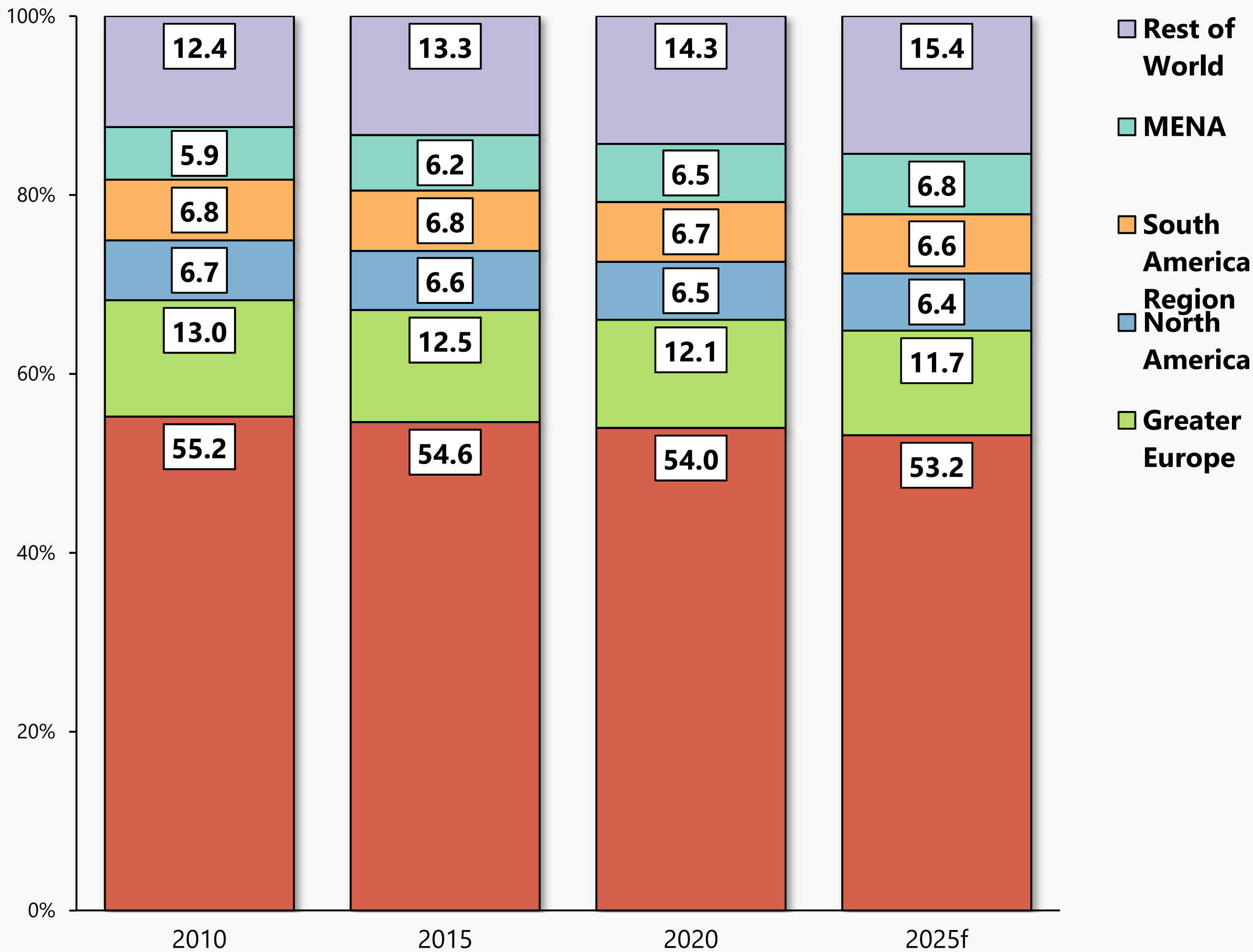
Regional Comparisons

Asia, as defined for this report, is the largest population region of the five, accounting for more than half (54%) of the world's population. The Greater Europe region accounts for 12%, and both North America and South America together account for 13%. Though the Middle East and North Africa (MENA) and the Rest of the World (Central Africa, South Africa, Australia and New Zealand) were not discussed regionally in the population section—as they only account for a combined 10% of the global economic output—they are included in the regional comparisons due to the significant population growth that will occur in those regions through the outlook period (Figure I-15).

Figure I-15

Regional Shares of Global Population, 2010 through 2025

Percentage of Population



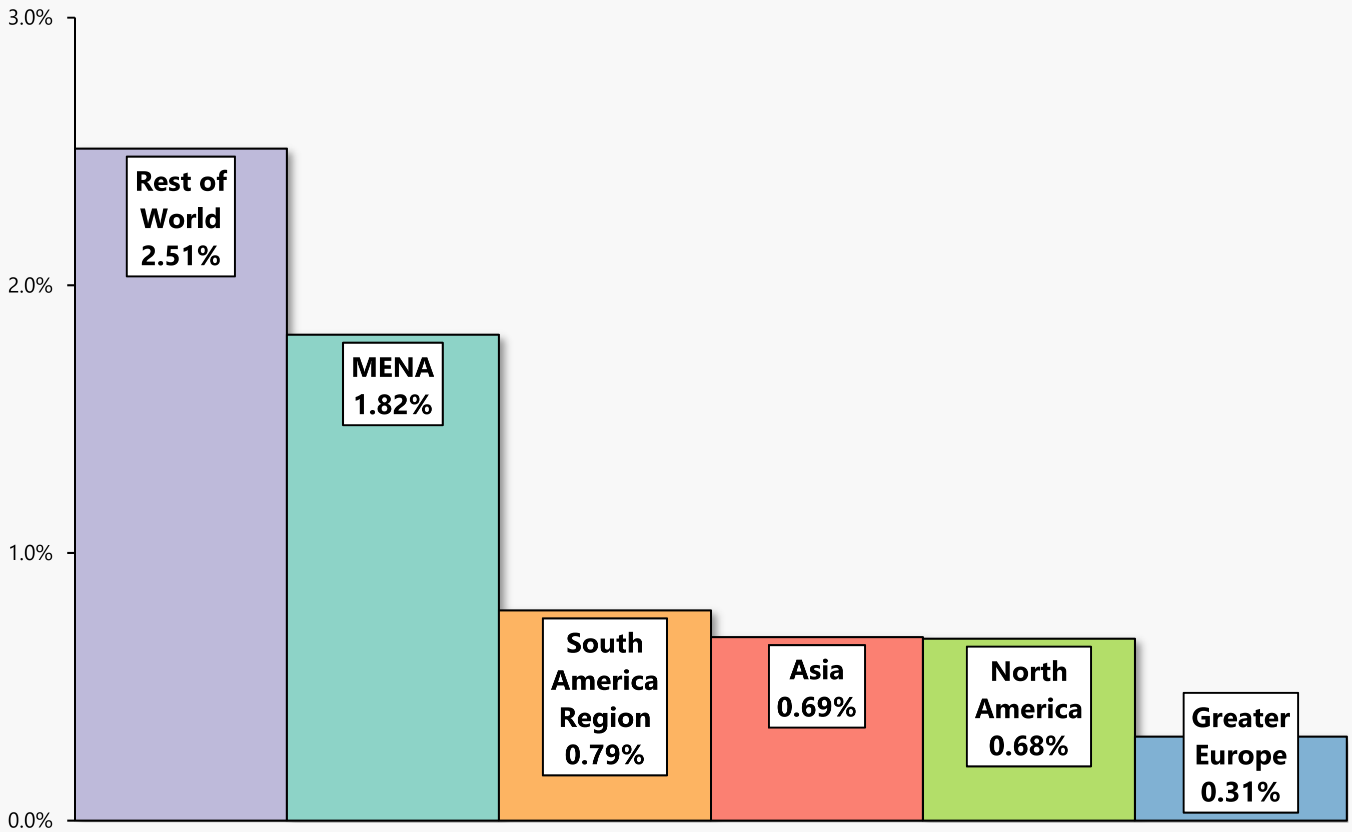
Source: IMF, 2021

Of the six regions, the Rest of the World and MENA have the fastest expanding populations, expanding 2.51% and 1.80%, respectively, through the forecast period. This compares to the previously discussed strong growth in Asia, which compared to the other two regions, appears relatively subdued (Figure I-16).

With the inclusion of the other two regions, growth rates across the regions group into three categories: robust (MENA and Rest of World both near two percent and above); moderate (Asia, South America, and North America all around one percent) and slow (Greater Europe, less than half-a-percent) (Figure I-16).

Figure I-16

Annual Growth of Population by Global Region



Source: IMF, 2021

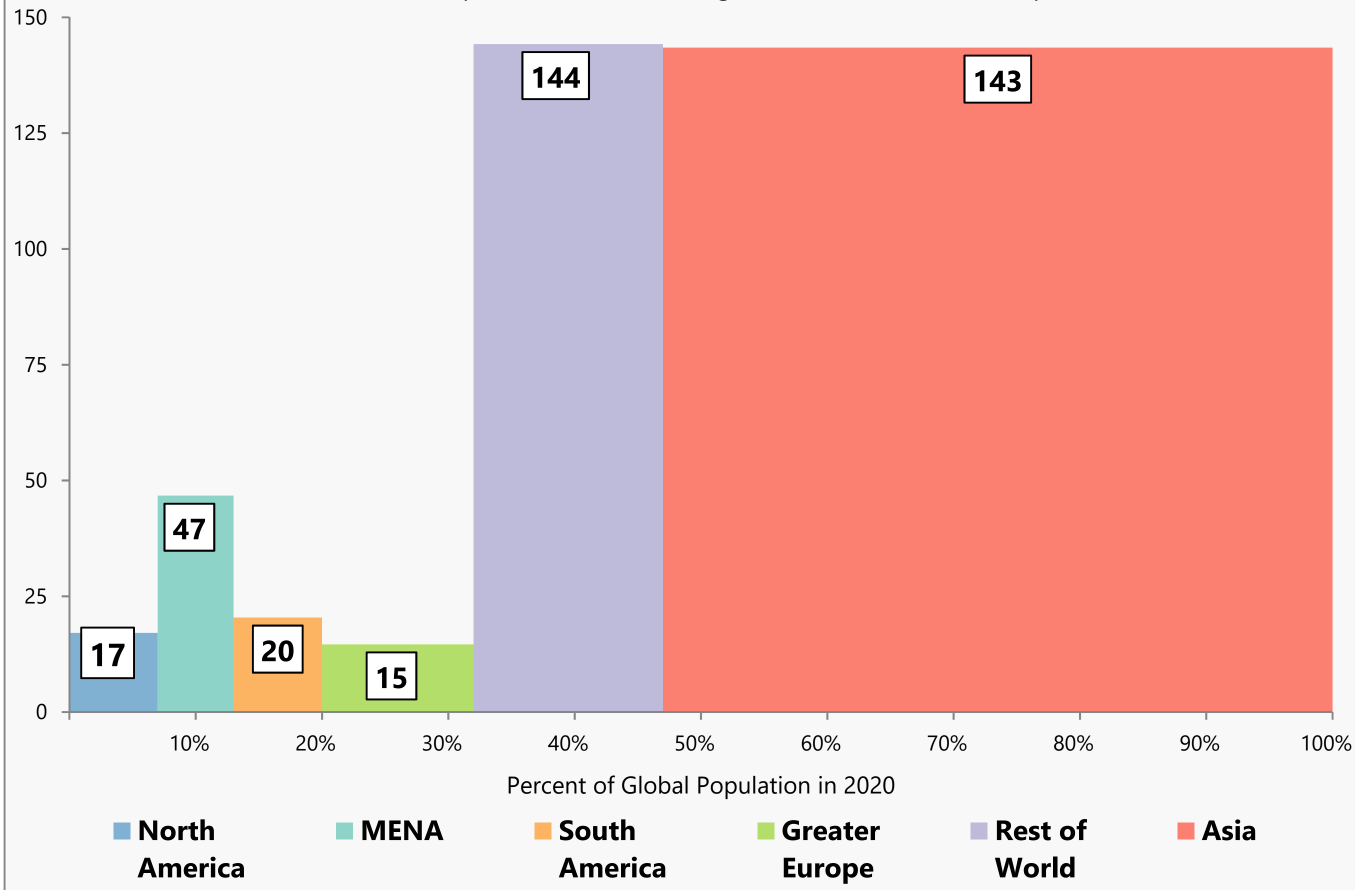
However, one must look beyond the growth rates to the total population change. Given the relative smaller sizes of the two high growth regions, the total number of people added to each region of the forecast period varies greatly.

Global population is forecast to increase by 387 million people through the forecast period. Three-quarters (74.4%) of the growth will occur in two regions the Rest of the World and Asia. The Rest of the World (primarily Central and South Africa) is forecast to add slightly more than one-third of the growth, adding 144.2 million people between 2021 and 2025, 37.3% of the total. Asia is forecast to add another 143.5 million people, 37.1% of the total growth. The remaining regions—which currently account for half (49.3%) of the global economic output—account for the remaining 25.6% of the population growth (Figure I-17).

Figure I-17

Population Growth by Region by Share of Global Population

Additional Population Added through 2020-2025, Million People



Source: IMF, 2021

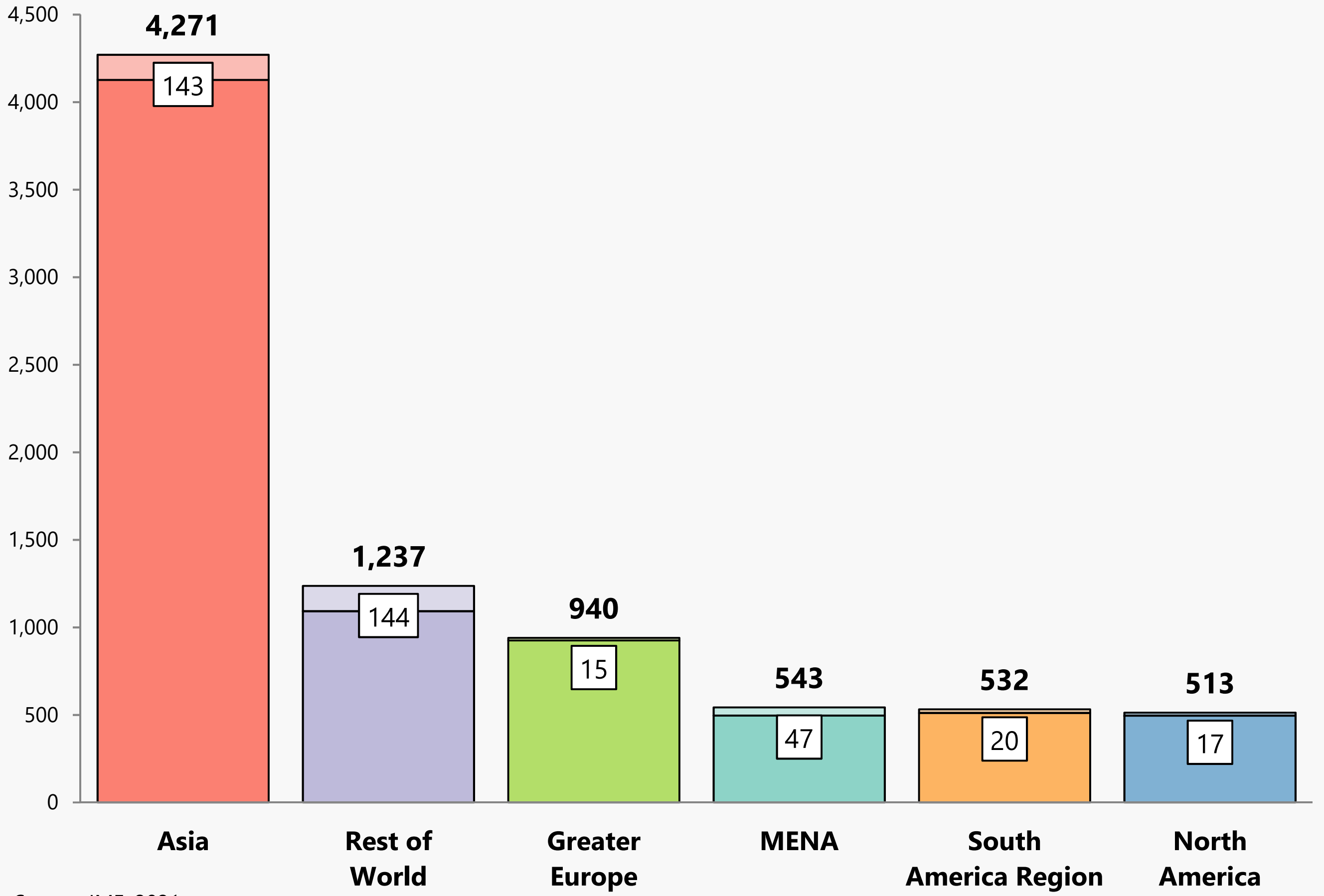
The figure below (Figure I-18) illustrates the total size of each region's population in 2020 with the incremental growth between 2021 and 2025 to reach the total population in 2025. Even though MENA and the Rest of the World are forecast to have robust growth rates, their total sizes still pale in comparison to Asia (Figure I-18).

Figure I-18

Global Population and Incremental Growth, 2025

Base = 2020 Population, Shaded Portion = 2021 through 2025 Incremental Growth

Million People



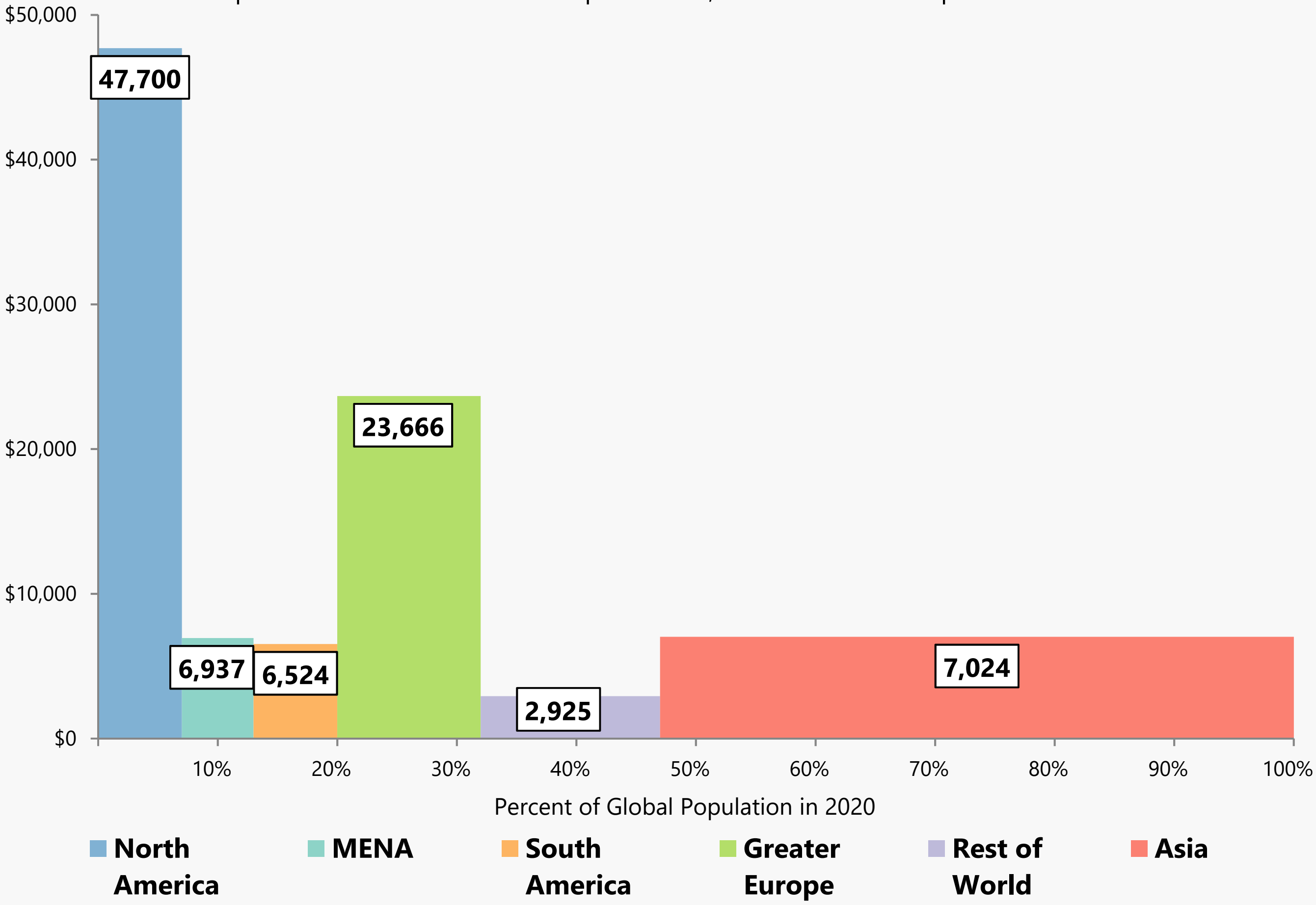
Source: IMF, 2021

As mentioned previously, GDP per capita serves as a benchmark in categorizing countries, not only as developing, emerging, or advanced, but also in terms of nonwoven end-use product purchase. For example, in general a country begins to use baby diapers when GPD per capita reaches US$3,500 and reaches the opportunity for 100% penetration around GDP per capita of US$23,500. So, while Asia accounted for 54% of the population in 2020, the GDP per capita for the region was $7,024 (Figure I-19). This number is above the threshold for some of the single-use products such as feminine hygiene (≈$1,000) and baby diapers (≈4,000), and now just above the threshold for baby wipes (≈$7,000) and below for incontinence products (≈$10,00) and other wipes products (≈$11,000). While much discussion centers around India and diaper consumption, in 2020 India's GDP per capita was $6,461 compared to China's $17,192.

Figure I-19

GDP per Capita by Region by Share of Global Population, 2020

Expressed in GDP in PPP Dollars per Person, In Reverse 2020 Population Order



Source: IMF, 2021

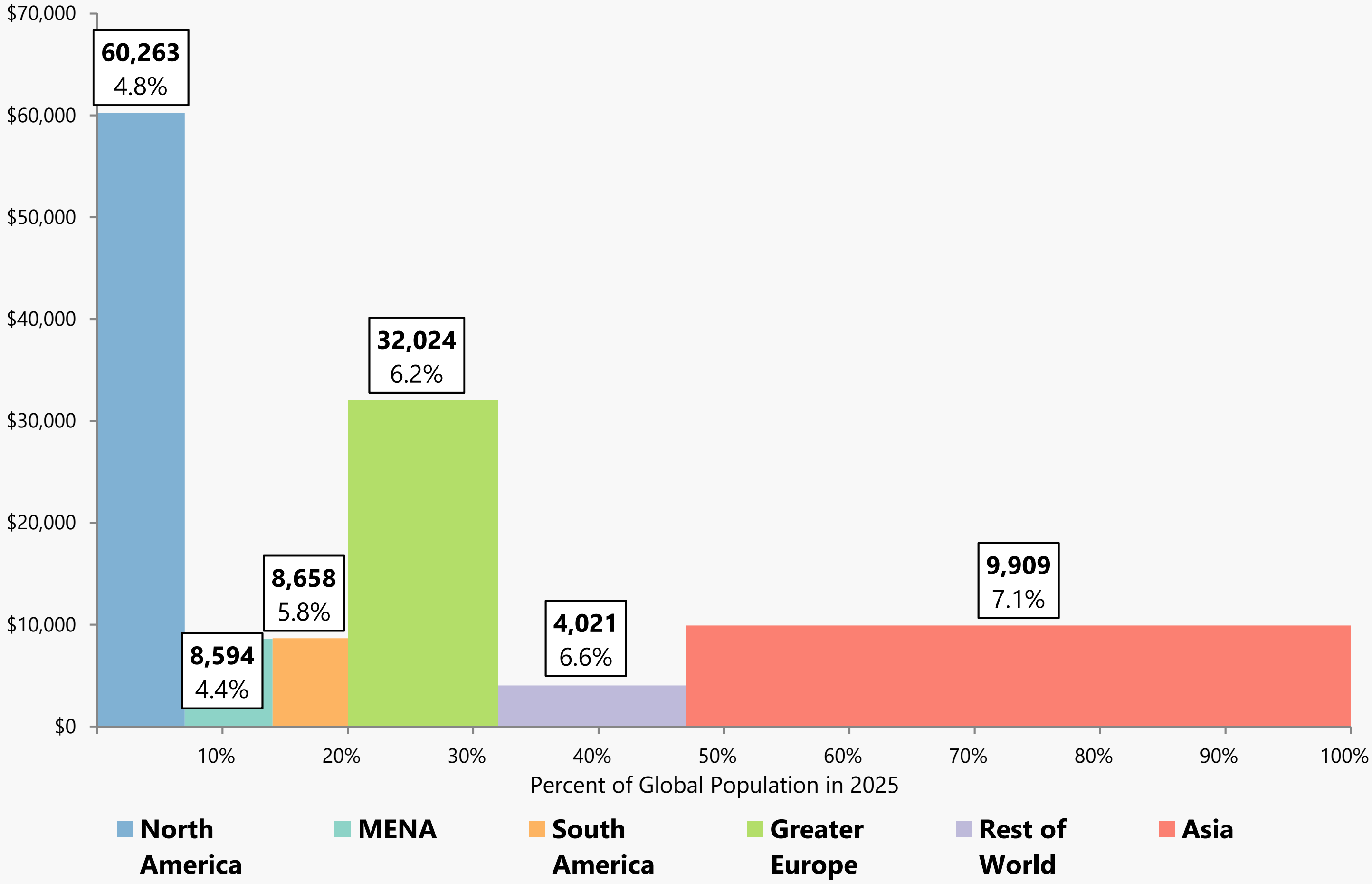
Interestingly, due to the pandemic, GDP per capita decreased in all of the regions, with the exception of Asia, from the previous issue of this report, the Worldwide Outlook for the Nonwovens Industry, 2018–2023. The South America region, also as a result of the natural disasters, experienced the greatest drop in GDP per capita dropping to $6,524 from $8,058, a 24% decline. MENA, Rest of the World, and Greater Europe also declined 9%, 7%, and 6%, respectively. North America experienced a slight drop, $200, just a 0.4% decline in GDP per capita. Asia's GDP per capita increased 4% from 2018 to 2020.

So one must look not only at population growth opportunities, but also at the financial means to purchase nonwoven end use products. The figure below (Figure I-20) provides a regional view of the forecast GDP per capita, the average annual growth rate of GDP per capita and the population for 2025.

Figure I-20

GDP per Capita by Region by Share of Global Population, 2025

Expressed in GDP in PPP Dollars per Person followed by CAGR, In Reverse 2020 Population Order



Source: IMF, 2021

As previously mentioned, many of the these regions include a mix of advanced, emerging and developing markets, so it may be useful to view the region's GDP per capita tables when determining market opportunities.

II. NONWOVEN SUPPLY

This section details the key indicators of nonwovens production globally by region and by technology process, according to the new ISO nonwovens definition (ISO 9092:2019) which was adopted at the beginning of 2019.

The worldwide production of nonwoven roll goods reached 17.86 million metric tonnes in 2020, equivalent to US$64.4 billion. The tonnage volume was equal to about 499 billion square meters in 2020 (Table II-1).

Table II-1

Outlook for Global Nonwovens Production

	2010	2015	2020	2025f	Annual Growth Rate 2010-2020	Annual Growth Rate 2021-2025
Tonnes (millions)	9.80	12.66	17.86	20.44	6.2%	2.7%
Square Meters (billions)	262.8	345.3	498.9	584.0	6.6%	3.2%
Dollars (billions)	40.6	45.5	64.4	78.2	4.7%	4.0%
Consumption per Person (kg per capita)	1.41	1.72	2.29	2.50	5.0%	1.7%

Source: EDANA/INDA, 2021

There are literally thousands of "grades" of nonwovens produced in the marketplace. The value of the global nonwovens market is an estimate, given the complexities of pricing across the numerous types of nonwovens and the further complication of exchange rates. Moreover, in 2020, an unprecedented unbalanced supply-demand in specific nonwoven materials induced erratic price developments. Average weights (gramme per square meters) can also vary a lot within those different types of materials, EDANA being the only body collecting companies information in both tonnage and square meters.

To calculate the nonwovens market value for 2025, the forecast does not take into account inflation nor developments within exchange rates. By 2025, possible fluctuations of both raw materials and energy costs in the different world regions will impact the evolution of the price of the different types of nonwovens.

For the last decade from 2010 through 2020, nonwoven tonnage increased at an average annual growth rate of 6.2%, rising from 9.8 million tonnes in 2010 to 17.9 million tonnes in 2020 (Table II-1). Based on the state of the world economy available at the time this report was developed, INDA and EDANA forecast that global nonwovens production will continue to grow; and expect that in the period from 2021 through 2025, the industry will expand at an annual average rate of 2.7% and reach a volume of at least 20.4 million metric tonnes.

This average annual growth rate of 2.7% for the forecast period could be seen as very conservative compared to the evolution recorded over the past decade, but this forecast—constructed on the starting point of December 31, 2020—is based on the very production high level reached in 2020. The significant growth rates in nonwoven materials used during the COVID-19 pandemic (absorbent hygiene, protective medical apparel, face masks/respirators, and wipes) more than offset, in terms of volumes, the loss in important sectors for this industry—like those materials used in the production of vehicles, building construction, geotextiles, and home & office furnishings.

Indeed, the global production increased by 12.7% in 2020 compared to 2019, far over the annual average rate recorded between 2010 and 2019, which was 5.5%. To reach the forecasted tonnage for 2025, the total production will grow on average by 4.3% from the 2019 level, about half a point lower than the industry was expected to grow over the period 2018–2023 in the previous edition of this Worldwide Outlook Nonwovens report. Therefore, if we use 2019 as reference, global nonwovens production volume will continue to outpace GDP in the long-term.

In terms of additional volumes, global nonwovens output increased by 5.202 million tonnes between 2015 and 2020 and by 4.862 million tonnes between 2014 and 2019. By 2025, the forecast growth will lead to global production of 2.577 million tonnes higher than five years before, but to 4.596 million between 2019 and 2025.

As a result of a further decrease of the weight per surface area or "grammage" as expressed in grams per square meter (gsm) on a worldwide basis, square meter volume is forecast to continue to grow at a faster pace. Newer nonwoven technologies are capable of producing nonwovens at lower weights while meeting the specified requirements. Thus, there is a continuing trend toward lighter weights of nonwoven materials, which reduces the overall tonnage required and the consumption of raw materials.

This is the case in absorbent hygiene products where the average weight of components has dropped considerably over the decade with weights today as low as 12-14 gsm. There is continuous pressure to reduce the cost of materials used in absorbent hygiene products and an expectation that the global industry will move to the 10-12 gsm range and to 8-10 gsm for specific applications. Typically, emerging countries develop medium and heavyweight nonwovens first and move toward developing lighter-weight materials as the consumer market grows. For certain applications, a reduction of the grammage was possible, and at times increased the attractiveness of nonwovens.

Production by Region

Production numbers not only include sales on the local market or export sales, but also nonwoven material manufactured for the producing company's own use. The regions are equivalent to the regions in the Macro-Drivers section (Section I). The table below provides a listing of the countries—principally those producing nonwovens—by region (Table II-2).

Table II-2

Definition of Nonwovens Production Regions

Primarily Nonwovens Producing Countries

Region	Countries Included
North America	Canada, Mexico, United States
Greater Europe	European Union's 27 nations plus the United Kingdom, Turkey, Norway, Switzerland, Russia, Belarus, and Ukraine
China	China, Hong Kong
Japan	Japan
Other Asia	Bangladesh, India, Indonesia, Malaysia, Nepal, Pakistan, Singapore, South Korea, Taiwan, Thailand, and Vietnam
South America	Argentina, Brazil, Chile, Colombia, Honduras, Paraguay, Peru, and Venezuela
Middle East and North Africa (MENA)	Algeria, Bahrain, Egypt, Iran, Israel, Jordan, Kuwait, Libya, Morocco, Qatar, Saudi Arabia, Syria and United Arab Emirates
Rest of World	Central and South Africa, Australia

Source: EDANA/INDA, 2021

In terms of geographical definition, Greater Europe includes both Eastern and Western European countries as well as Turkey, Russia, Belarus and Ukraine. Considering the market connections, not only in nonwovens but also in upstream and downstream industries, between the Middle East and North African countries, these countries are analyzed together within one single region (named MENA). The MENA region covers countries from Israel to Saudi Arabia and from Morocco to Iran. When possible, China is broken out separately from the Asian market due to its specific growth and volume. The

Rest of the World category includes mainly the rest of Africa, with countries like South Africa and Nigeria, and Australia.

The table below (Table II-3) provides the global outlook for nonwovens production by major world region, as recorded over a 10-year period from 2010 through 2020 and forecast to 2025.

Table II-3

Outlook for Nonwovens Production by Region

(Thousand Tonnes)

Region	2010	2015	2020	2025f	Growth (AAGR) 2010-2020	2020-2025
North America	3,591	3,866	4,761	5,370	2.9%	2.4%
Greater Europe	2,069	2,574	3,076	3,481	4.0%	2.5%
Asia	3,389	5,305	8,750	9,870	9.9%	2.4%
China	2,385	3,919	7,063	7,900	11.5%	2.3%
Japan	313	342	301	343	–0.4%	2.7%
Other Asian Countries	691	1,043	1,386	1,627	7.2%	3.3%
South America Region	442	459	691	838	4.6%	3.9%
MENA	264	392	496	742	6.5%	8.4%
Rest of World	43	65	90	139	7.7%	9.0%
World Total	**9,799**	**12,662**	**17,863**	**20,440**	**6.2%**	**2.7%**

Source: EDANA/INDA/ANFA estimates, 2021

Historically, the major producing regions have been North America (the United States, Canada and Mexico), Greater Europe and Japan. The combined volume of these three regions used to account for roughly three-quarters of the world's nonwovens production. This was the case in the 1990s and early 2000s, but times have changed.

Japan's economy has been stagnant since 2011 and higher energy costs have moved many Japanese nonwovens companies' new investments out of Japan (see increasing Japanese imports of nonwovens roll goods in Chapter IV International Trade). This can explain that Japan's share of world nonwoven output has declined over the past decade. North America's growth has come from the three countries: United States, Canada and Mexico. European nonwovens statistics include figures of developing (as far as nonwovens are concerned) countries, such as Turkey and Russia, which both recorded impressive growth rates since 2010.

Asia is by far the dominant nonwoven producing region, accounting for 48.9% of the world's production in 2020, up from 34.6% in 2010. China accounts for a significant proportion (80.7%) of the Asia volume and remains the largest nonwovens producer globally with production volume in 2020 estimated at 7.063 million tonnes and equivalent to more than a third (39.5%) of global nonwovens production in 2020 (Table II-3). Reports emanating from China show higher volumes than the ones included in the report by EDANA and INDA. It is difficult to reconcile the higher volumes with our analysis of both local demand and export market, partly due to perhaps a broader nonwovens' definition—some Chinese figures may include waddings or woven technical textiles—and unused capacity recorded as actual production.

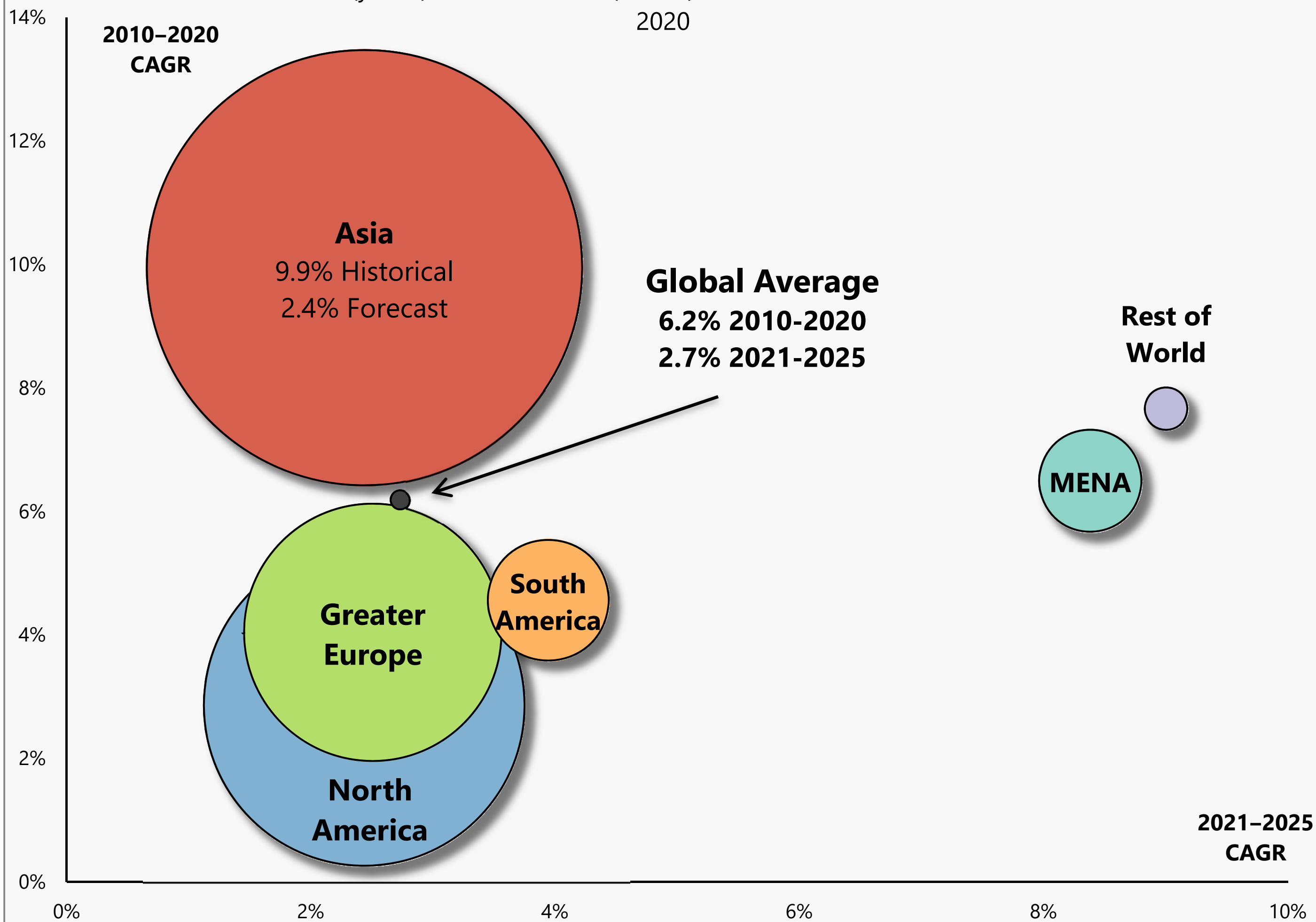
The next figure (Figure II-1) provides a graphical representation of Table II-3 and summarizes the historical growth (2010 to 2020 average annual growth rate, AAGR) along the y-axis and the forecast growth (2020 to 2025 AAGR) along the x-axis, by the weight of the region's production (in 2020) represented by the size of the circle.

The figure clearly illustrates that the three main regions—North America, Greater Europe and Asia—combined, now account for the majority (92.9%) of the world's total nonwovens production. The figure also clearly shows the significant growth of the Asian region. Asia has had the fastest historical growth and is forecast to have one of the fastest growth rates in the future.

Figure II-1

Nonwovens Production by Region Market Sizes and Growth

Historical CAGR (y-axis), Forecast CAGR (x- axis) and Bubble Size in Tonnes of Production, 2020



Source: EDANA/INDA Estimates, 2021

The center of the each circle is where the historical and forecast growth rates intersect; along the vertical axis (y-axis) Asia's historical annual growth was 9.9%, and along the horizontal axis (x-axis) Asia's forecast is 2.4% (Table II-3).

The figures below (Figures II-2, II-3 and II-4) graphically represent the evolution of the tonnage output of the nonwovens industry by the world regions for periods of 2010, 2020, and the expected 2025 production volumes.

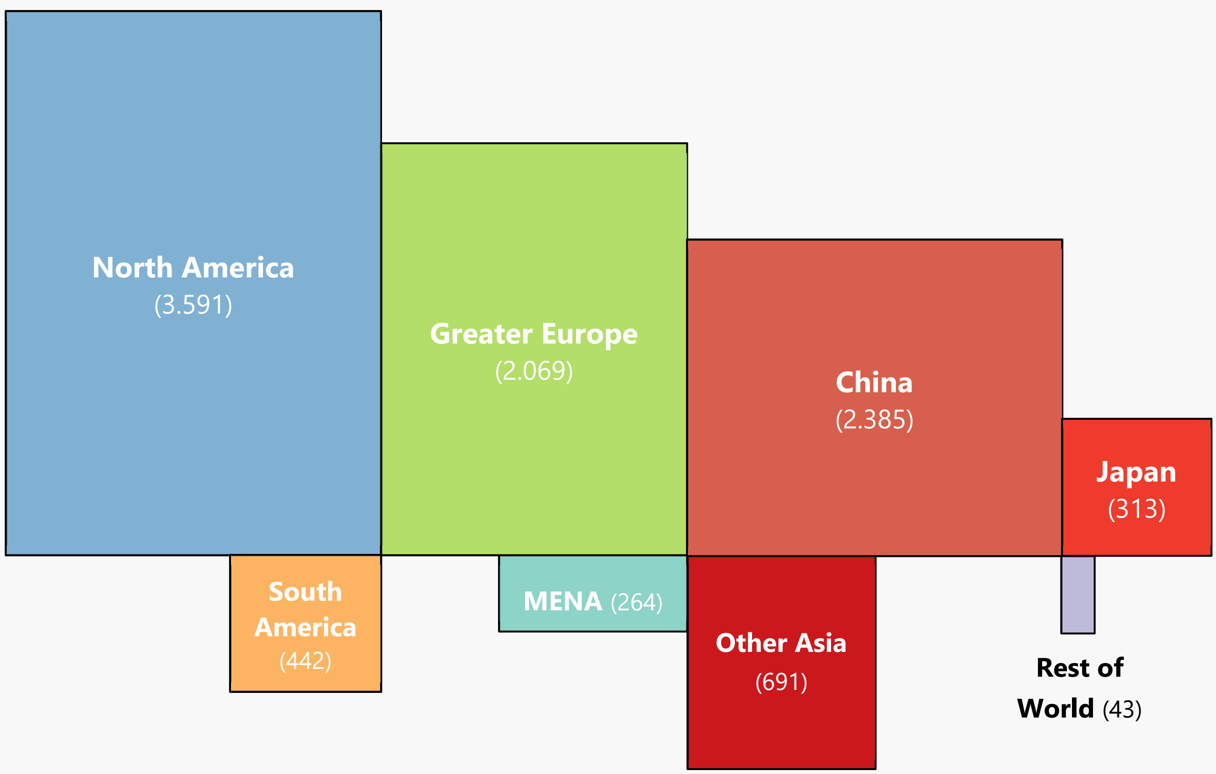
The nonwovens industry grew 6.2% year-over-year between 2010 and 2020, and the boxes grow significantly; specifically, China recorded a double digit growth of 11.5% year-over-year during that time (Figure II-3).

Through the forecast period nonwovens production is forecast to expand 2.7% year-over-year, while China continues to expand at a lower speed of +2.3% but based on very high 2020 output (Figure II-4). MENA (+8.4%), South America (+3.9%) and Rest of World (+9.0%) regions will record faster growth than the world average until 2025.

Figure II-2

Nonwovens Production by Region in 2010

(Thousand Tonnes)

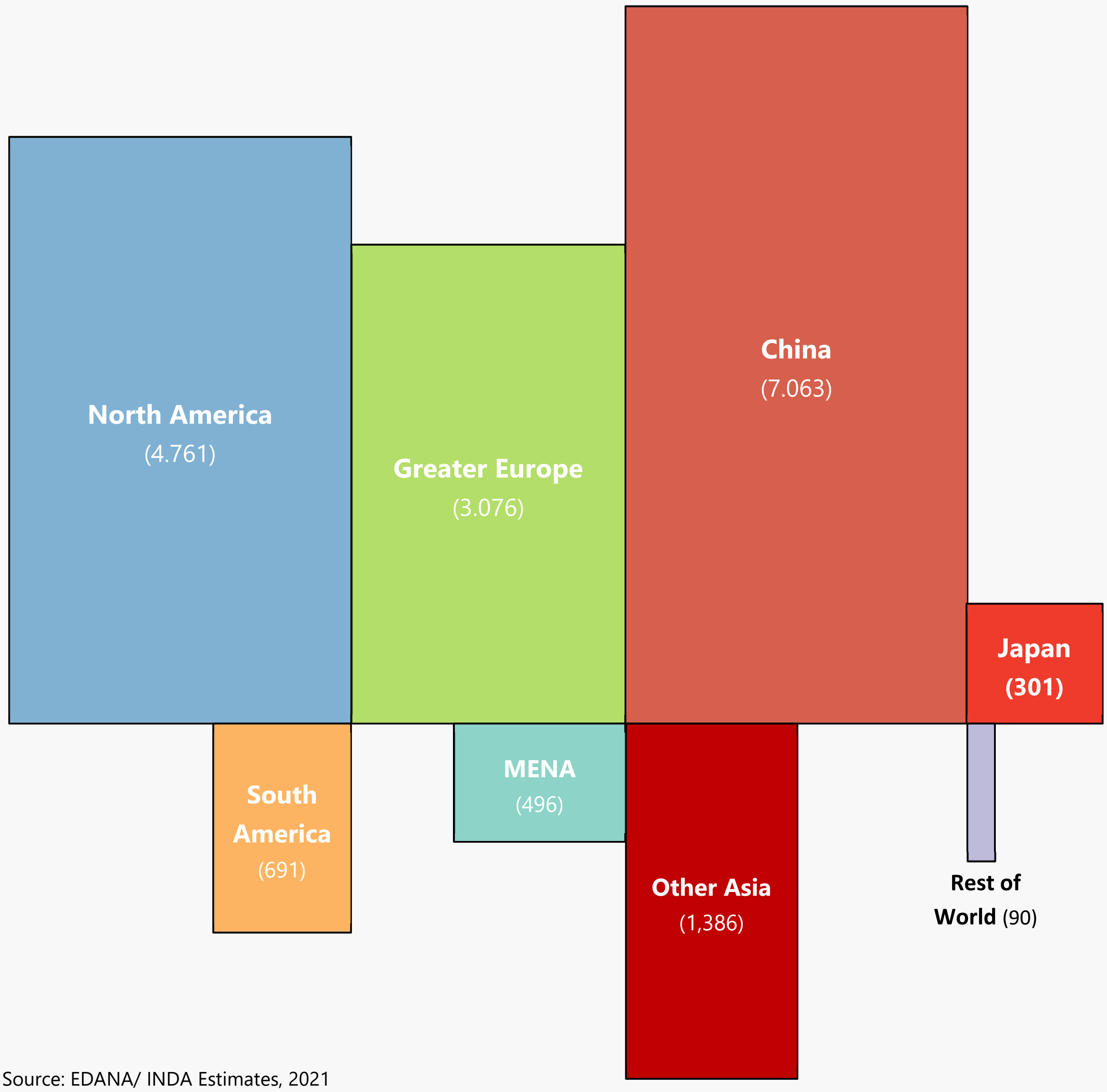


Source: EDANA/ INDA Estimates, 2021

Figure II-3

Nonwovens Production by Region in 2020

(Thousand Tonnes)

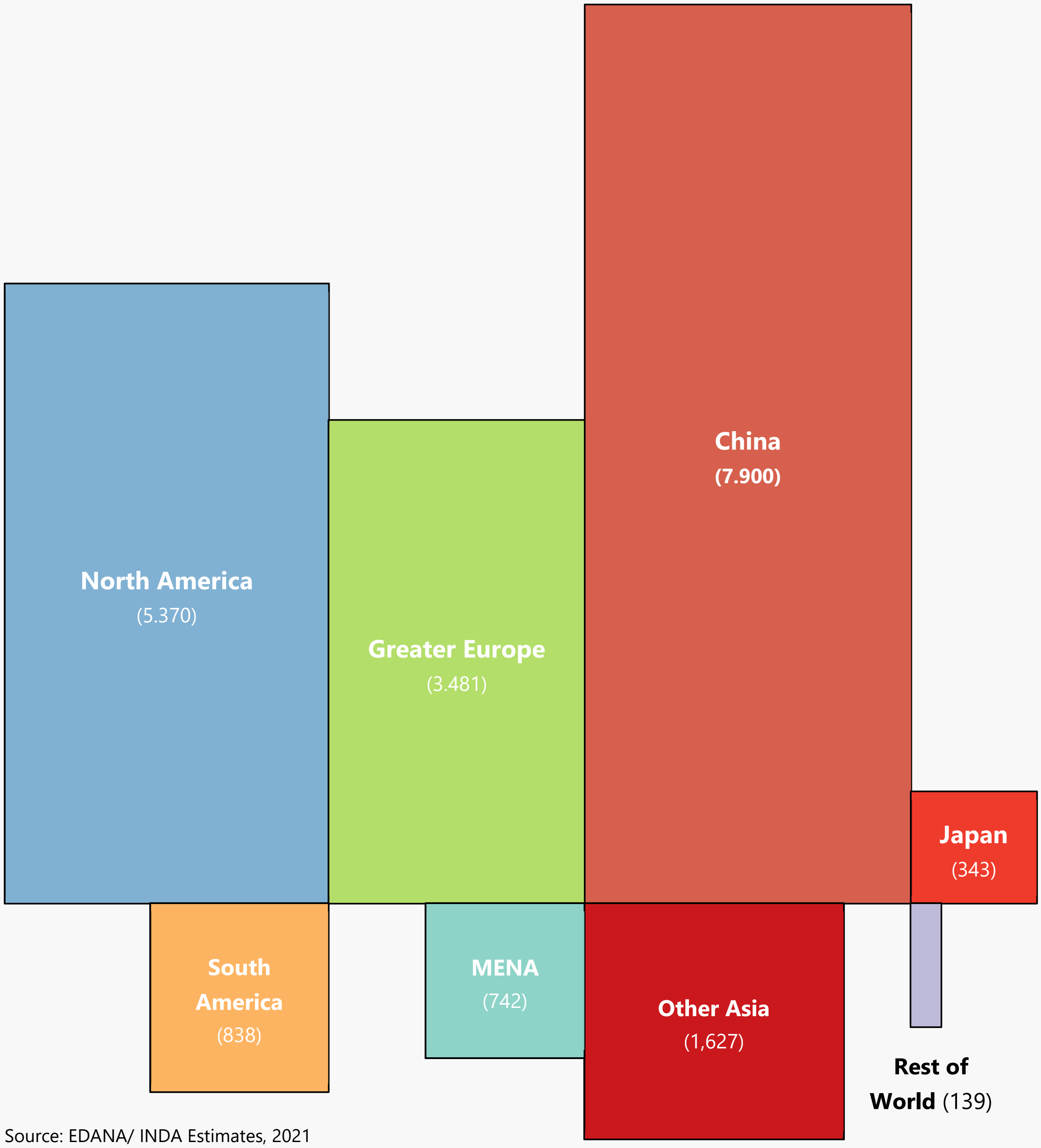


Source: EDANA/ INDA Estimates, 2021

Figure II-4

Nonwovens Production by Region in 2025

(Thousand Tonnes)



Source: EDANA/ INDA Estimates, 2021

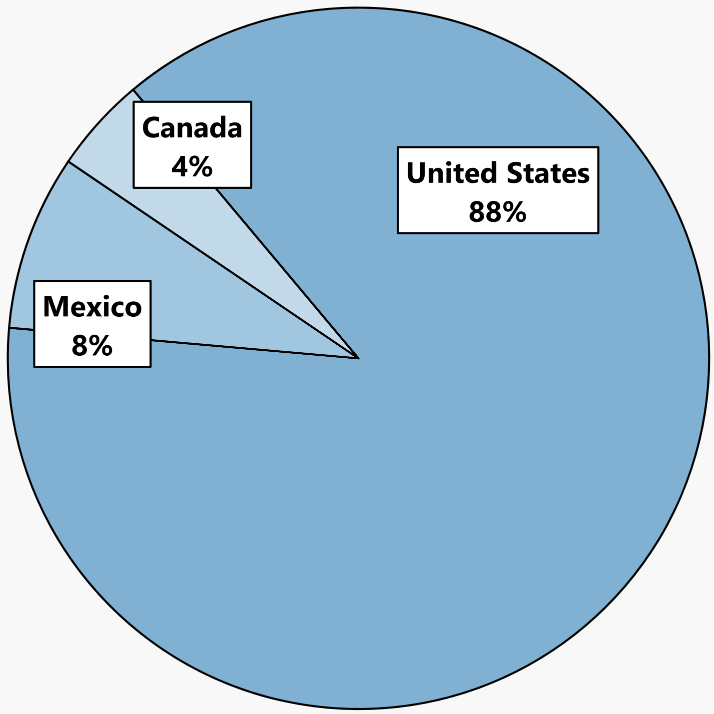
North America

Similar to the economic share, the **United States** represented 88% of the region's nonwovens production in 2020 (Figure II-5).

Figure II-5

North America Nonwovens Production by Countries

Tonnes, 2020



Source: INDA, 2021

In 2020, the production of nonwovens in North America reached 4.8 million tonnes, an increase of 895,500 tonnes from 2015 (+4.3% annually). In the previous period (2010–2015), North America added only 274,400 tonnes (+1.5% annually) (Figure II-6).

The nonwovens output of this region, after experiencing 2.9% annual growth over the last decade, will keep growing by 2.4% per annum through the forecast period. This represents an average annual tonnage growth in the forecast period of 121,800 tonnes, compared to the average annual tonnage added in the previous five years of 179,100 tonnes/year (Figure II-6).

One of the points of reference for the **continued strong forecast growth rate** is that the annual average production growth increased significantly in the last five years (2015-2020) from the previous five-year period (2010-2015), as the impact of lightweighting most likely slowed—in addition to capacity rationalization—in the spunlaid processes, and the growth in housing construction and filter media improved the wetlaid process production. From 2005 to 2010, production expanded at a 5.7% annual rate, while due to a few years of declining production impacted by the slow recovery from the Great Recession, production expanded at only 1.0% annually from 2010 to 2015 (Figure II-6).

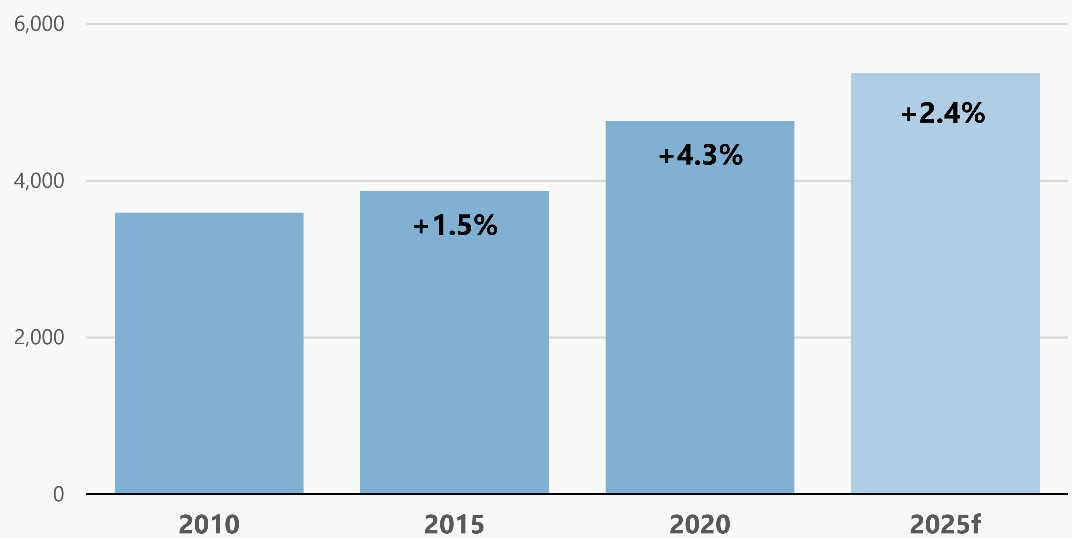
Through the forecast period North American real GDP is also forecast to expand 3.2% annually, with nonwoven production expanding at a slower rate (+2.4%), given the COVID-19 induced boost in production in 2020 (3.5%) (Figure II-6).

Figure II-6

North American Nonwovens Production

In Thousand Tonnes

Annual Percent Change (AAGR) from Preceding Period



Source: EDANA/INDA estimates, 2021

As stated in the Macro-Drivers section (Section I), the strength of the economy and demographic trends are the significant drivers of demand within the nonwovens industry; North America is no exception. While the outlook of both are improving, the economic improvement is a result of the bounce back from the pandemic and the positive impact of demographic changes (births and aging population) are in later years of the forecast, resulting in nonwoven production growth about that of region's long-term economic potential.

Greater Europe

In Greater Europe, one must differentiate between the three sub-regions, as they are experiencing different trends. These sub-regions are:

- The **European Union** (referred to as EU27) and the other European nations, which are located within Europe but are not members of the Union, like the United Kingdom, Norway and Switzerland;
- The **European former Soviet Union** states: currently mainly Russia, Belarus and Ukraine; and
- **Turkey**, a significant producer of nonwovens and textiles.

The European Union commenced with six nations and expanded to a union of 28 nations (EU28) when Croatia has completed its negotiations with the European Union, and, on July 1, 2013, became the twenty-eighth EU member country. On January 1, 2021, the United Kingdom officially left the European Union after several years of BREXIT negotiations. In this report, European Union past data and forecasted numbers include these 27 member states.

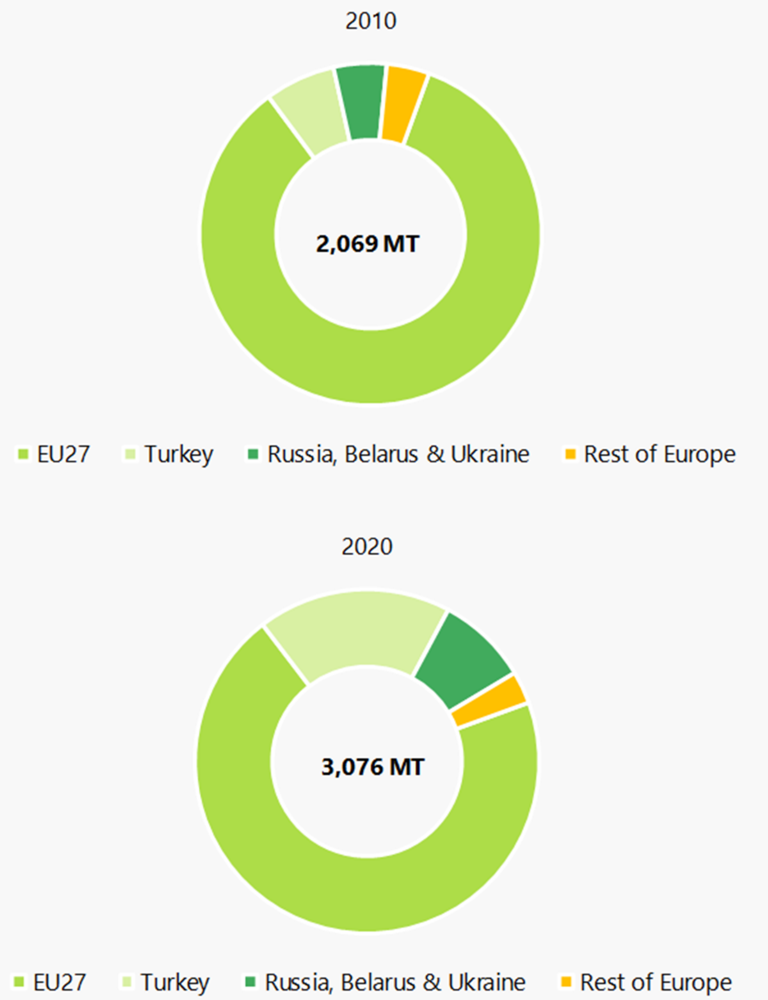
While Turkey is still negotiating its EU membership, Iceland cancelled its application in March 2015. Iceland had applied for EU membership in July 2009. Although the Commission issued a favorable opinion in February 2010, and the Council decided in June 2010 to open negotiations, a new government took over in May 2013 and decided to put these accession negotiations on hold. Regardless of this position, Iceland has had a bilateral Free Trade Agreement with the European Economic Community (EEC) since 1972, and two-thirds of Iceland's foreign trade is with EU member states.

The population of the European Union nations at the end of 2020 was below one-half billion (447.0 million) persons, since the United Kingdom left. There are several countries scattered within Europe that have not joined the Union. These countries include Iceland, Norway, Switzerland, the components of the former Yugoslavia (Bosnia and Herzegovina, Kosovo, Macedonia, Montenegro, Serbia), Albania and, now, the United Kingdom (68.2 million). In order to get the Greater Europe population, one has to consider also Russia (145.9 million), Belarus (9.4 million), Ukraine (43.5 million), and Turkey (85.0 million). Therefore, Greater Europe as defined is a large region with a growing population nearly approaching 900 million people in 2021, more than the three North American countries together (501.3 million).

With regards to the nonwovens industry, the twenty-seven countries of the European Union comprise together the majority of production within Greater Europe, accounting for 84% of the production in 2010 but dropping to 70% in 2020, as both Turkey and the former Soviet Union countries increased their share: Turkey from 7% to 18%, and Russia, Belarus and Ukraine from 5% to 9% (Figure II-7). The "Rest of Europe" production figures include the output of Norway, Switzerland and the United Kingdom.

Figure II-7

Greater Europe: Nonwoven Production by Main Sub-regions 2010-2020



Source: EDANA, 2021

European production statistics (Figure II-8) provide all the Greater Europe nonwovens production in 2010, 2015 and 2020, including EU27, the United Kingdom, Turkey, Norway, Switzerland, Russia, Ukraine, Belarus and the component states of former Yugoslavia. According to the figures compiled every year by EDANA, Greater Europe's production of nonwovens grew in the 10-year period of 2010-2020, rising from 2.1 million tonnes in 2010 to over 3.1 million tonnes in 2020. This represents an average annual growth rate of 4.0% over the 10-year period including the 2020 upturn and despite the increasing amount of roll goods and finished products imported from outside Greater Europe.

Production in Greater Europe will experience a lower nonwoven growth of around 2.5% until 2025 (Figure II-8), relative to its 2020 level. One can consider this expected rate as conservative and very low compared to the evolution recorded in 2010-2020. Nonetheless, 2020 was not in line with long-term trend in Europe and these 2025 forecasts follows the expected long-term development of the local demand and the trend observed in the export market.

The production of nonwovens in Greater Europe jumped by 7.2% in 2020 compared to the previous year, mainly due to the urgent need for hygienic and medical materials and despite depressed durables' markets. With 2019 as reference, long-terms annual average growth rates are more comparable, with +3.7% in 2010-2019 and +3.3% in 2019-2025.

Looking at the local needs, nonwoven demand from Eastern European countries is expected to remain strong as these nations further build their industrial bases and raise their standards of living, but Western European countries have already reached high penetration rates in several major end uses for nonwovens. Western European consumption of diapers and feminine hygiene products, still the two main applications of nonwovens consumed, has shown limited growth in 2015 through 2020, and will not show higher growth rates until 2025, because of the already high penetration rate and the demographic trends. Trends in adult incontinence and wipe segments will be driving the growth in nonwovens for single-use segments.

After an unexpected growth in 2020, the European consumption of medical nonwovens is uncertain during the next period and will depend on the sanitary conditions, the regulation and the competition from imported converted items.

In durables segments, automotive nonwovens faced the dramatic drop of the global production of vehicles in 2020. Nevertheless, the use of nonwovens in a car will continue to increase (even if electric vehicles specific needs will be reshuffling the nonwovens portfolio used) and volumes will be linked to the recovery of this market segment. The European Union's recovery plans based on infrastructures improvements have increased consumption and production of nonwovens, in particular for construction projects.

Looking at the export market, the development of a local nonwovens production in countries where European producers used to export large amounts of roll goods (and where converters also send final products) will impact the European production. Some of these developing countries may have more capacity than their market needs in specific products and—with the help of easier access to cheaper raw materials—may export more to Europe and compete with local manufacturers.

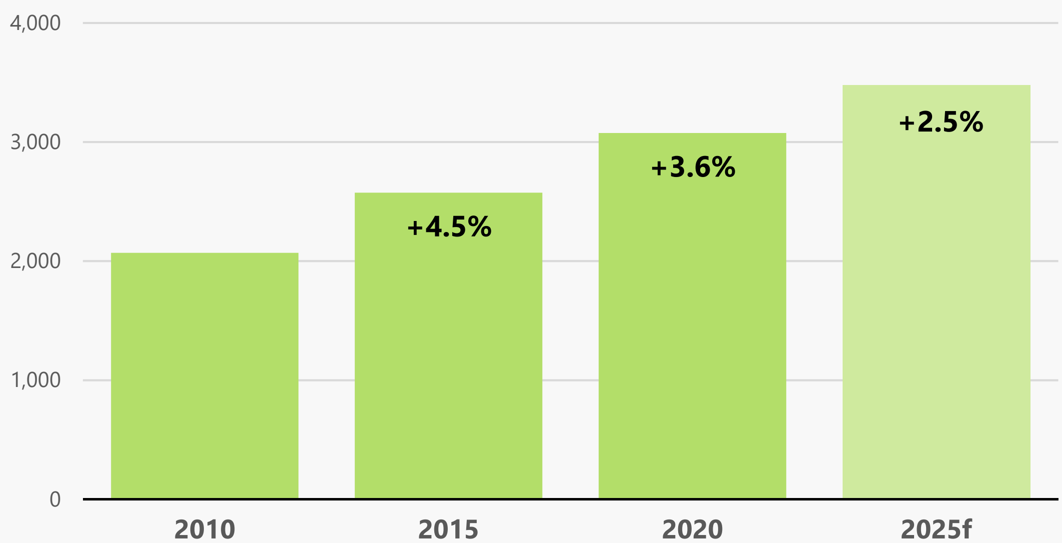
Opportunities to sell outside Europe (export) and competition from outside (import) will also depend on trade conditions and the evolution of the EU's euro, Turkish lira, and Russian ruble exchange rates with other currencies. The euro is now the common currency in 19 of the 27 European Union member states. The value of the euro against the U.S. dollar showed a negative trend over the period 2010–2016 followed by an improvement in 2017–2020. While a Euro-zone crisis could potentially restart during the forecasted period (which would have an uncertain impact on the local economy), it was assumed that the euro would not collapse during the period considered in this report.

Figure II-8

Greater Europe Nonwovens Production

In Thousand Tonnes

Annual Percent Change (AAGR) from Preceding Period



Source: EDANA/INDA estimates, 2021

Greater European output growth portrayed in Figure II-8 is partly attributed to the expansion of the European Union's production which increased by 2.2% annually on average during the last decade, thanks not only to the local demand but also to a sustainable growth of exports of both nonwovens roll goods (see Chapter IV International Trade) and converted products. However, the development of Russia and Turkey have also to be underlined. Over the period 2010-2020, both countries became very important players in the nonwoven industry.

In 2020, only Russia, Belarus and Ukraine (except other marginal and very limited productions) were producing nonwovens within the former Soviet Union countries located on the European continent. Nevertheless, their activity, which was still relatively low in 2004 (less than 16,000 tonnes) has grown over the last ten years from 103,500 tonnes in 2010. Almost all technologies, except carded air-through bonding, have now been implemented in these countries. Their total output in 2020 was estimated at 263,500 tonnes and the industry is still expected to expand. Even if the local production was first aimed to a large extent at the construction sector, the development of a local absorbent hygiene products industry is contributing to the plans for extensive growth of nonwovens production, mainly in Russia (226,000 tonnes produced in 2020). This growing local production impacts the rest of Europe as well. Russian exports of nonwovens has been multiplied by more than five in one decade and 60.1% of these exports were to other European countries and 38.5% to Asian countries (see Chapter IV International Trade).

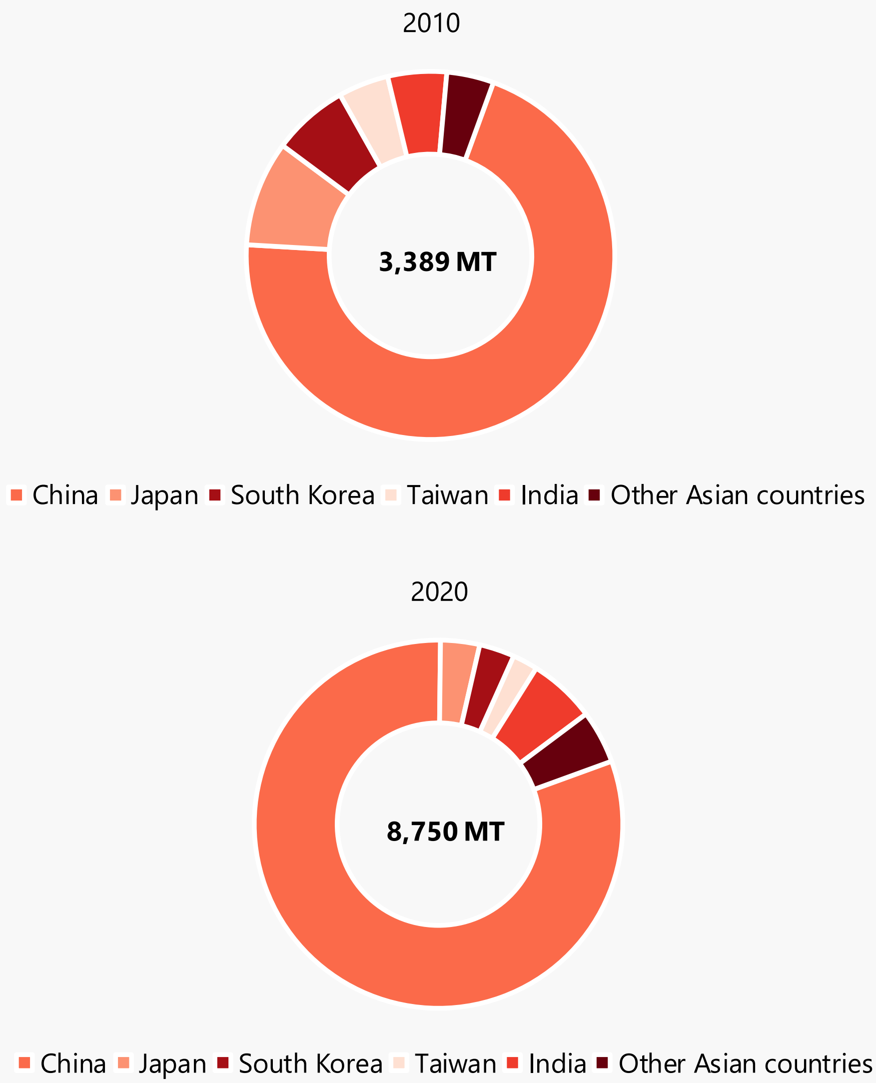
Turkey's nonwovens production statistics are isolated within EDANA's published yearly statistics. In 2020, Turkish nonwovens production represented 18% of the Greater European output (it was only 7% a decade before) or 3.1% of the world production. It recorded an annual average growth rate of 15.0% over the last decade and has nearly doubled since 2014. Turkish production of fiber-based and spunlaid materials together exceeded 560,000 tonnes in 2020, of which 248,000 tonnes were exported outside Turkey. Indeed, Turkey is an important supplier of the Middle East countries, both in nonwovens and converted items. All web-forming and web-bonding processes are now present in Turkey although spunmelt (44.0%) and carded hydroentangled (38.5%) were the main technologies in 2020 in terms of volumes produced. Further increases of capacity have already been announced in Turkey.

Asia

The overall nonwovens production in Asia **more than doubled in one decade**, from 3.4 million tonnes in 2010 to 8.8 million tonnes in 2020 (see Figure II-9). However, each of the Asian countries moved forward at different rates.

Figure II-9

Evolution of the Asian Nonwovens Output in Tonnage 2010-2020



Source: ANFA, 2021

In a growing Asian production, China increased its market share in Asia from 70% in 2010 to 81% in 2020. In terms of growth rate, the Indian and Chinese nonwoven industry recorded the highest rates in the 2010–2020 time frame, with an annual average growth rate of, respectively, 11.4% and 11.5%. Nowadays, Indian total output accounts for 6% of the Asian nonwovens production (Figure II-9).

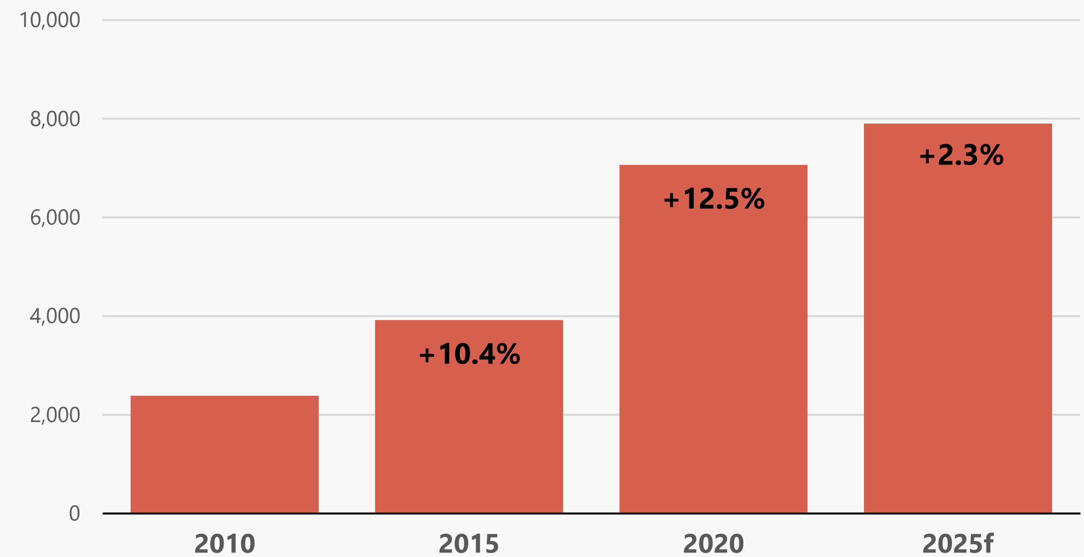
Over the last 5 years, high nonwovens production growth has been observed in many Asian countries, other than India and China. Other Asian countries, Thailand, Indonesia, Taiwan, and Malaysia rapidly expanded even if, for some of them, the growth has been slowed down by the sanitary crisis in 2020. Moreover, new production plants appeared in countries where there was no nonwoven industry before such as Nepal and Bangladesh.

Figure II-10

China Nonwovens Production

In Thousand Tonnes

Annual Percent Change (AAGR) from Preceding Period



Source: ANFA/EDANA/INDA estimates, 2021

The highest increase in volume was recorded in the Chinese nonwovens industry. Its 11.5% annual average growth rate over the last decade representing 4,678,000 tonnes more than in 2010 has confirmed China as the largest roll goods producer in the world. In the previous Figures II-2 and II-3, one easily notices that China overtook both North America and Greater Europe in tonnage. China's nonwoven output in the early 1990s was less than 100,000 tonnes, but over the years, the country installed considerable nonwovens production capacity. In 2010, Chinese output was 2.4 million tonnes, and 7.1 million tonnes of nonwoven materials were produced by China by 2020 (+31.4% compared to 2019, representing 1.7 million additional tonnes in one year).

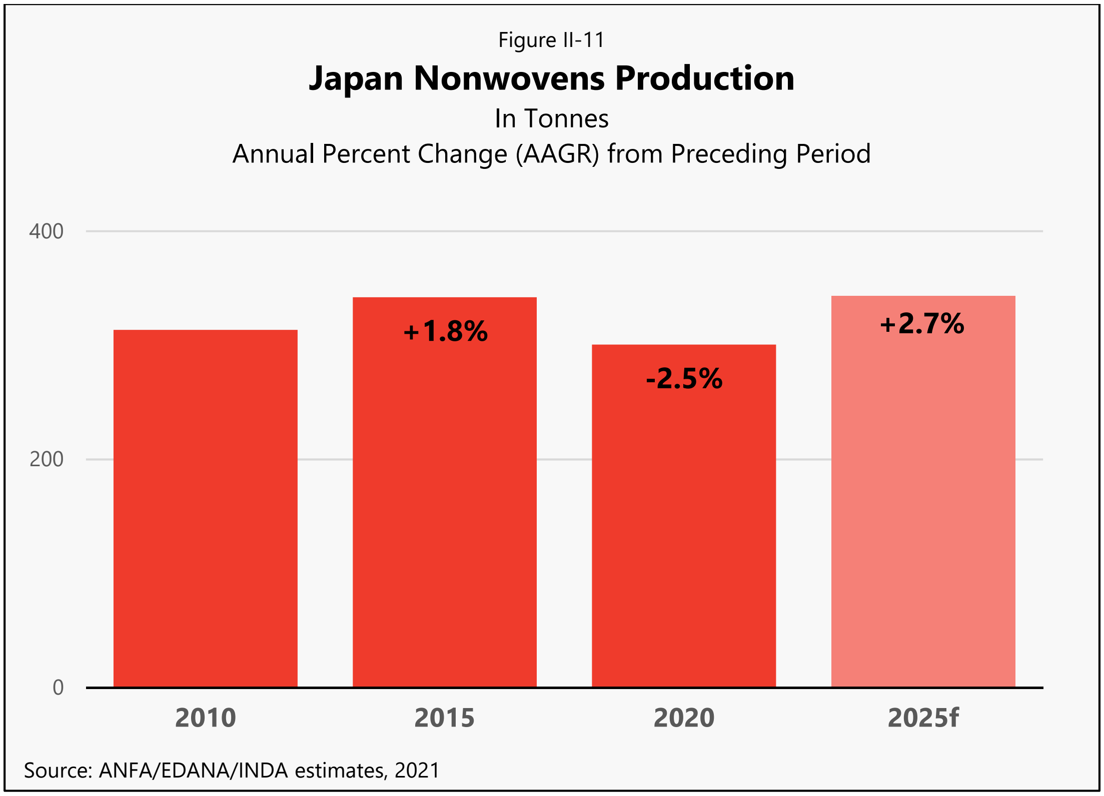
New investments from abroad and domestic development made this growth possible. Indeed, domestic Chinese nonwoven enterprises have improved dramatically, and several have entered the global top 40 nonwovens businesses. Concurrently Chinese exports exploded; they overtook one million tonnes already in 2019 and they reached 1,389,000 tonnes in 2020.

It is obviously difficult to maintain this type of production growth rate, in particular after the year 2020 when China had to supply a huge amount of roll goods and medical items to the rest of the world. Moreover, the increasing nonwovens production of other Asian countries will also slow down the development of Chinese exports to these countries.

As mentioned in the Macro-Drivers section, in 2013 began easing enforcement of the "one child" policy in certain circumstances. It then raised the limit to two children for all families in 2016, in hopes of encouraging a baby boom. It did not work. After a brief uptick that year (the birth rate went from 12.07 in 2015 to 12.95 in 2016), the birth rate (12.43) and number of births fell again in 2017, with 17.23 million babies born compared to 17.86 in 2016, and has continued to decline. According to preliminary data, around 12 million babies were born in China in 2020, the lowest since China relaxed its one-child policy. It also marks the lowest official birth rate in China since 1961, however; there are widely held concerns about the historical data collection

Originally it was believed the end of China's "one child" policy would impact many local nonwovens market segments, notably absorbent hygiene; however, this no longer appears to be valid and has been taken into account in the forecasts.

It is forecast that the country's nonwoven growth will slow to about 2.3% per year (based on the high level of production in 2020) through the coming five-year period to 2025. Using the year 2019 as a reference, Chinese nonwovens output will continue to grow by 6.6% until 2025, following a 9.4% average annual growth rate between 2010 and 2019. Nonetheless, it means that, in 2025, China will produce 11.8% more than in 2020 equivalent to 840,000 tonnes (Figure II-10).



Japan's nonwovens production was down by 6.5% in 2020 compared to 2019, with volume at about 301,000 tonnes from 313,000 tonnes ten years before, but peaked at 343,000 tonnes in 2018. That low rate does not mean that the Japanese nonwoven industry is not growing. Leading companies of the Japanese nonwoven industry made significant investments in new facilities in neighboring countries, like China, Indonesia, and Thailand, where the production costs are lower. Imports of nonwovens roll goods into Japan reached 269,000 tonnes in 2020 (it was 108,000 tonnes ten years before).

While Japan is a high-cost producer of nonwoven materials, the Japanese producers have been successful at developing specialized, excellent quality, high-value nonwoven materials that are directed towards small specialty or niche markets. In 2020, Japan was still in the position to export high price nonwovens, which more than compensated for the growing volumes of imports (see hereafter Chapter IV International Trade).

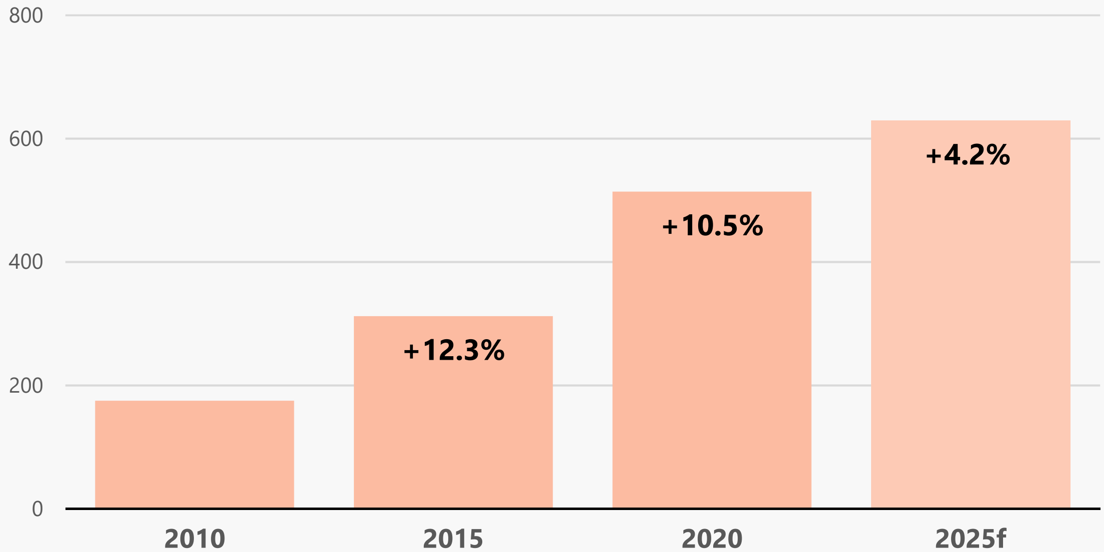
Nonetheless, a higher growth rate is foreseen, 2.7% for the next period to reach again 343,000 tonnes by 2025. This growth will be driven mainly by the evolution of spunlaid and drylaid-needlepunched materials (Figure II-11).

Figure II-12

India Nonwovens Production

In Thousand Tonnes

Annual Percent Change (AAGR) from Preceding Period

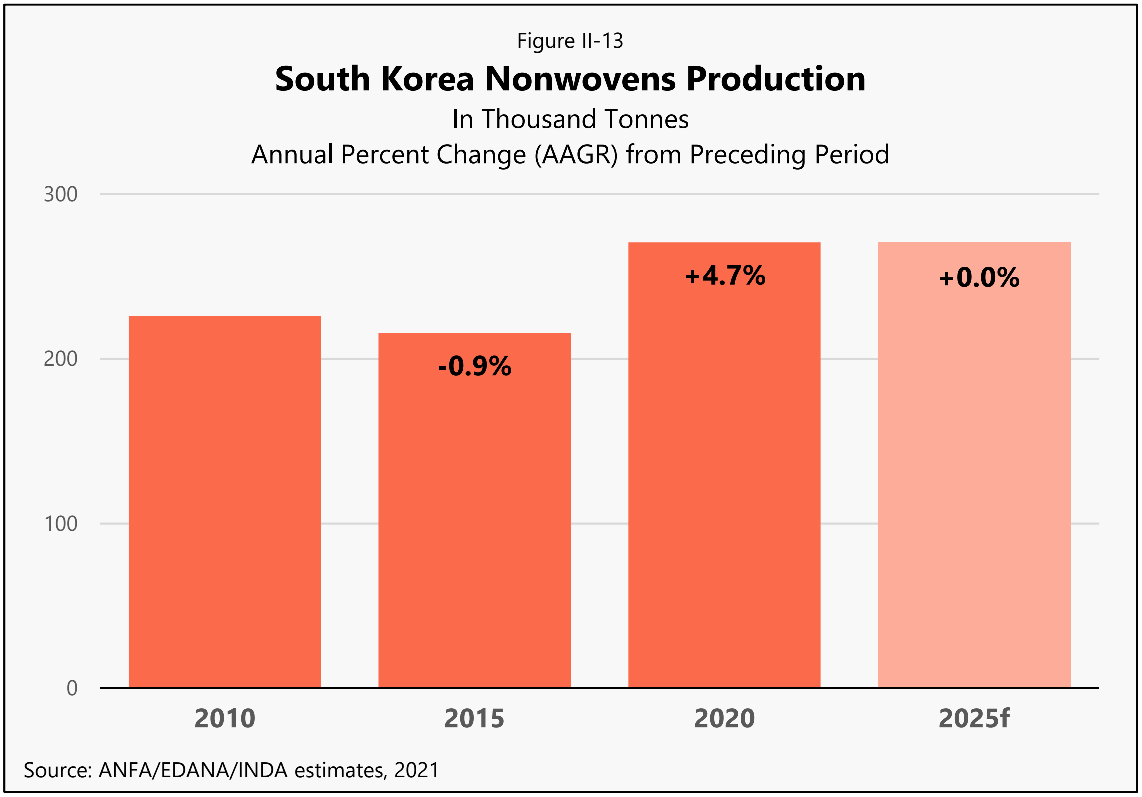


Source: ANFA/EDANA/INDA estimates, 2021

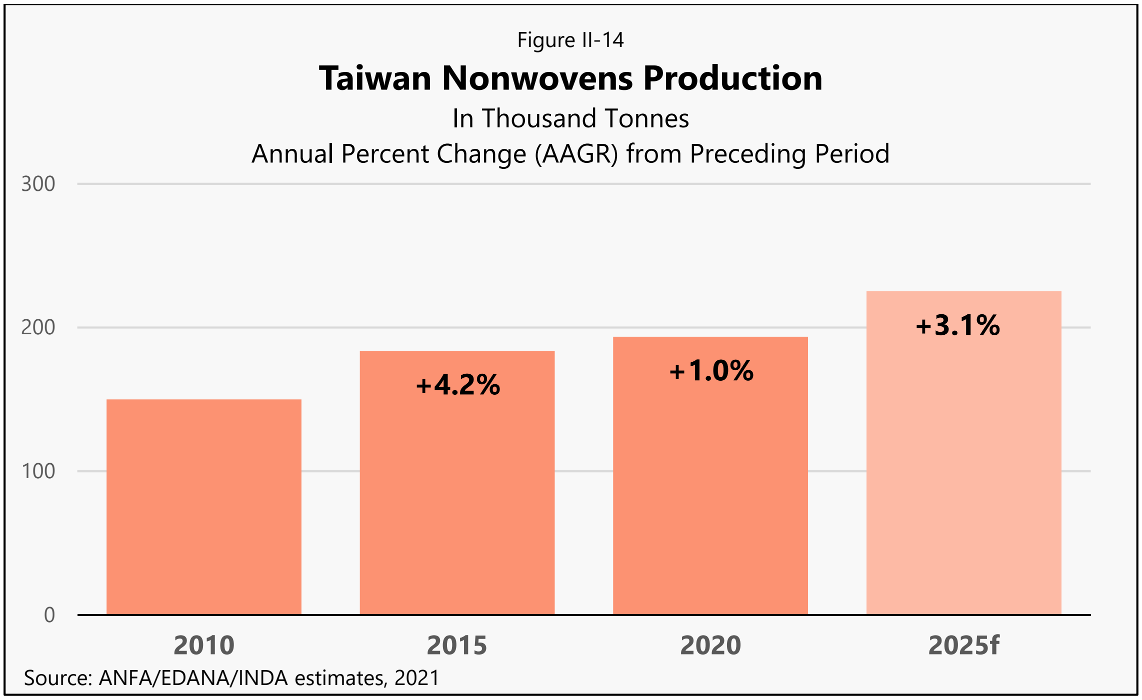
Traditionally, drylaid-needlepunch has been the principal nonwoven technology in India, with many lines processing materials made from natural fibers and cotton waste. Since 2011, investments in spunbond lines, in both Reifenhäuser systems and inexpensive technologies imported from China, were made, and spunlaid is now the first technology in India in terms of tonnage produced. Over recent years, Indian nonwovens output has increased significantly, as displayed in Figure II-12. India is now the second largest Asian supplier of roll goods, with an estimated 514,000 tonnes in 2020, but it reached 536,000 the year before. However, for the very first time, India had a positive trade balance in 2020.

Considering the potential demand of a population comparable to that of China, India nonwovens output is expected to continue to grow, most probably at a slower pace during the forecast period, estimated at 4.2% to reach 630,000 tonnes of which 355,000 tonnes are spunmelt materials.

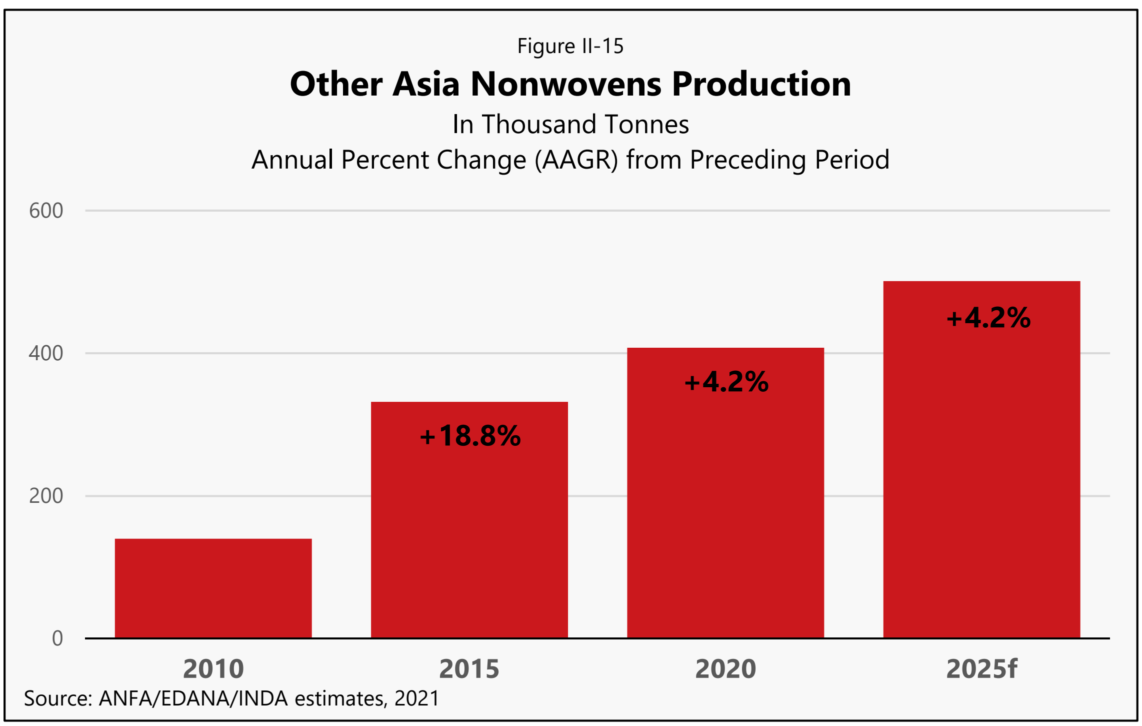
The other two leading nonwovens producing nations in Asia are still South Korea and Taiwan. South Korea's nonwovens volume in 2020 was 271,000 tonnes, up from 226,000 tonnes in 2010, and represents a real annual growth averaging 1.8%. The South Korean nonwovens industry production should not record major evolution in the years to come and is foreseen to be quite similar by 2025 (Figure II-13).



Taiwan has a well-developed nonwovens industry with all the major drylaid technologies, including mainly drylaid-hydroentangled (quite stable since 2017 at 79,000 tonnes in 2020). Taiwan also has both spunbond polyester and polypropylene technologies, for a total output of around 62,000 tonnes in 2020, and further investments and improved utilization rates are expected in these two technologies by the end of the forecast period. Taiwan's overall output of nonwovens in 2020 was 194,000 tonnes and should reach 225,000 tonnes in 2025, a 3.1% annual average growth rate in line with the growth observed since 2010 in this country (Figure II-14).



The "Other Asia" region includes mainly Indonesia, Thailand and Malaysia, as well as smaller suppliers like Bangladesh, Nepal, Pakistan, Kazakhstan, Turkmenistan, Uzbekistan, and Vietnam. The combined nonwovens production of these countries has nearly quadrupled in ten years and was estimated at 407,700 in 2020. A further increase of 4.2% is expected by 2025 (Figure II-15).



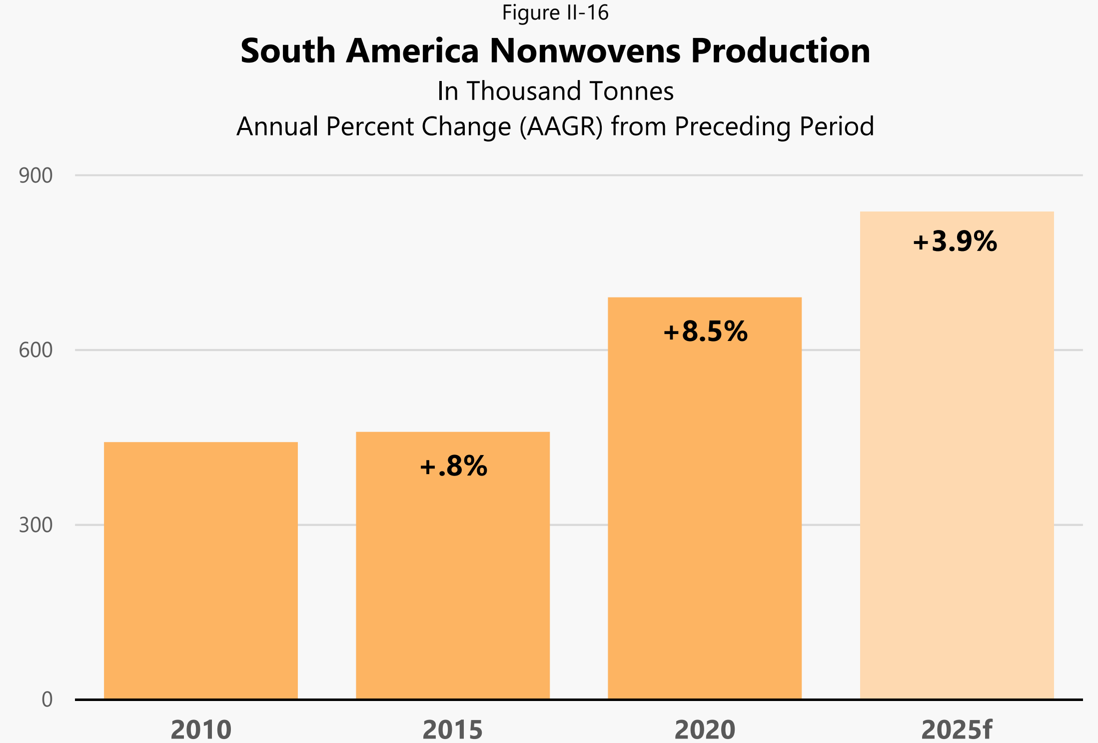
South America

Within the South American region (South America, Central America, and the Caribbean), the nonwoven industry is primarily centered in the continent of South America; few if any producers are located in the Caribbean or Central America. Most of the nonwoven materials used in those two regions are imported from either the United States or Mexico. However, Colombia exports into the Caribbean and Central America, as it is another major source of nonwoven production in South America.

Brazil is the dominant nonwoven producing country in the region, accounting for 70% of the region's capacity in 2020. The nonwovens industry has significant history in Brazil with over two-thirds of companies established more than twenty years ago and nearly a quarter established about 50 years ago. It is the headquarters of one of the major multi-national nonwoven companies, Fitesa. Berry Global's acquisition of Avintiv, formerly Polymer Group Inc. (PGI), consolidated their position in the continent, as PGI had acquired in June 2014 a controlling interest in Companhia Providencia Industria e Comercio (Providencia), a Brazilian nonwoven company, in addition to their Colombian and Argentinian subsidiaries. These two companies—Fitesa and Berry Global—now control the much of the spunlaid capacity in the South America region.

Numerous suppliers in the South American nonwoven industry are essentially unknown. Many of these companies go undetected as it is estimated only 60% of nonwovens in the region are sold as roll goods, while the remaining 40% are produced within vertically integrated operations and sold as finished products. This makes obtaining production numbers difficult, particularly for the drylaid industry. It is easier to track the spunlaid companies as they are fewer in number, and the largest are public entities.

Figure II-16



Source: EDANA/INDA estimates, 2021

In 2020, the production of nonwovens in South America reached nearly 700 thousand tonnes (691,000), an increase of 249,000 tonnes from 2010 (a 4.6% average annual growth), as the economy flourished in the beginning of the historical period and nonwoven investments flowed into the region, though production did take a downturn as the economy slowed in the later years of the historical period. Most of the growth of the South American production actually happened between 2016 and 2020, 9.2% annually on average.

The nonwovens output of this region, after experiencing 4.6% annual growth over the last decade, is forecast to grow 3.9% annually through the forecast period (Figure II-16). This growth may seem optimistic in comparison to the economic outlook; the previous five years real GDP growth was –1.0% annually, with nonwoven production significantly exceeding the region's economic growth. The region's real GDP growth is forecast to expand 3.1% annually, at which time the region's GDP per capita will continue to increase, making additional single-use nonwovens affordable. Further, the region will continue to receive capital investments in the nonwovens industry and other manufacturing facilities that require the use of nonwovens in the production of their goods.

There are many end uses for nonwovens, and even though spunlaid usually gets the most attention due to the brand-name global companies that participate in the industry, much smaller producers using other technologies, primarily needlepunch, have been active participants in the overall growth. There is not one country in the region that does not have at least one producer of needlepunched blankets, an end use not always recognized as a nonwoven.

The absorbent hygiene segment will one of the major drivers for the overall growth of the industry in the region as more spunlaid capacity is added to accommodate those requirements. Market penetration, as well as catching up to mature market diaper designs, will promote further spunlaid growth, at a faster pace than the number of babies using diapers. Presently, there appears to be excess spunlaid capacity caused by the contraction in diaper sales in some of the main diaper-consuming countries.

Demographic trends, such as the aging population in Brazil, will favorably influence consumption of hygiene nonwovens in South America. The incontinence market, admittedly starting from a relatively low basis, will grow fastest.

Wipes continue to show growth in several countries, primarily Colombia and Brazil. The overall category is driven by the consumption of baby wipes. Further uses outside the original purpose for wiping babies are increasing, making a pre-moistened wipe a more multi-functional wipe. Other types of wipes will slowly begin to surface as the market matures, resulting in more growth for the region. Household wipes are practically non-existent as a category, although kitchen dish wipes and some standard cleaning wipes exist in small volumes.

End uses in the transportation and filtration segments will continue to see growth. Currently, the region has not reached the same consumption levels of nonwovens in automobiles experienced in the mature markets, as not all nonwoven technologies are available within the region. This situation will change, and the transportation industry will begin increasing their nonwoven consumption as manufacturers move to global platforms of lighter weight vehicles for fuel efficiencies and less expensive materials. Currently, both of these market segments have been depressed, though they are expected to rebound through the forecast period.

Middle East and North Africa (MENA)

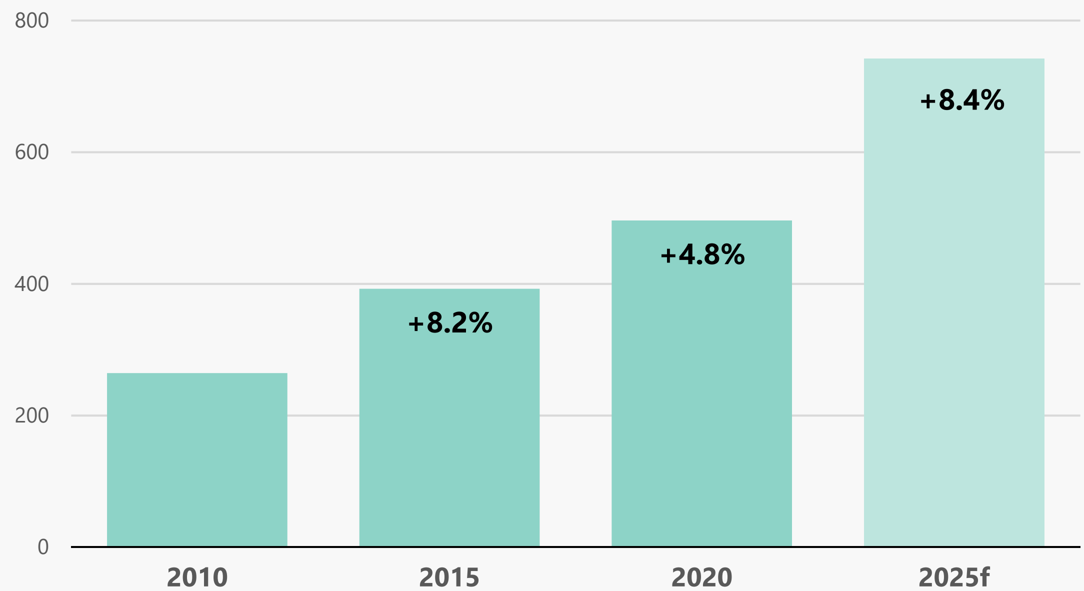
Nonwovens output in the markets of the Middle East and North Africa region are now referred to by the acronym MENA. It includes a heterogenous group of countries in terms of demography, political background and economic situation. In 2020, the MENA countries produced together about 496,000 tonnes of nonwoven materials and are forecast to reach 742,000 by 2025. The nonwovens output of this region, after experiencing an average growth of 6.5% over the last decade, will keep growing by 8.4% annually during the forecast period (Figure II-17).

Figure II-17

MENA Nonwovens Production

In Thousand Tonnes

Annual Percent Change (AAGR) from Preceding Period



Source: EDANA/INDA estimates, 2021

Nearly half (48.4%) of nonwoven production in 2020 was from the spunlaid technology, mainly in polypropylene low-weight materials, though some polyester resin lines have also been installed since 2009. The lines installed over the last decade were state-of–the-art technology, mostly multi-beamed and polypropylene. Spunbond polypropylene is now produced in Egypt, Iran, Israel, Jordan, Morocco, Qatar, Saudi Arabia and the United Arab Emirates. Currently, more than 30 spunbond polypropylene and associated spunbond/meltblown technologies are in production in the region, but not necessarily running at full capacity everywhere.

New production lines were announced and some of them were scheduled to come on line in 2018-2020, but political uncertainty in the region has slowed down the process. However, considering the size of the population in some countries and the region's aspiration to raise its standard of living, these new investments should only be postponed and could take place during the forecast period.

Until 2013, Israel was the main nonwovens supplier of the region. In 2014, Saudi Arabia recorded further growth of its nonwoven output and reached nearly the same output as Israel. Israel's and Saudi Arabia's 2020 output are estimated respectively at 134,000 tonnes and 129,900 tonnes. Nevertheless, 83% of the materials produced in Saudi Arabia were spunlaid. In contrast, a large part in tonnage (65%) of the roll goods produced in Israel are drylaid materials.

Iran and, since 2013, Egypt are important producers in the region as well. While Iran was still mainly a supplier of drylaid materials, new investments in Egypt—mainly from European companies—focused on spunlaid technologies. Egypt increased its production to supply its local demand and to export not only to other African countries, but also to Europe. Of its 47,000 tonnes of exports in 2020, Egypt supplied 18,600 tonnes to European countries and 16,400 tonnes to African countries (see Chapter IV International Trade).

By 2025, Israeli nonwovens production is expected to show further growth (+2.9% in average). Saudi Arabia's output is forecast to increase by 8.5% every year, in line with the +8.6% yearly average recorded between 2010 and 2020. Major developments of the nonwovens industry should also occur in both Egypt and Iran. In Egypt, improved utilization rates of existing capacities and new investments capacities will increase again the production. Egypt will be the third supplier of the region after Saudi Arabia and Israel. In the case of Iran, despite the current uncertain political and economic context, it was assumed that an increasing demand for nonwovens will have to be fulfilled, at least partly, by the development of local production which is forecasted to reach 130,000 tonnes by 2025.

Rest of the World

The “Rest of the World" region includes the rest of Africa (the African countries not listed in the MENA region) and the Oceania countries, mainly Australia.

In 2020, on the rest of the continent of Africa, active nonwoven production plants are to our knowledge mainly found in the country of South Africa. South Africa has a long history of making nonwovens. Recently announced projects were mainly in needlepunch for geotextiles and automotive applications and spunlaid for hygiene.

Nevertheless, we noticed an increase in the local demand of roll goods in other African countries currently still met by imports. By 2025, we expect an increase of the needs of nonwovens in the rest of Africa, partly fulfilled by the development of the local production, which is included in the forecast numbers for 2025.

On the other hand, the nonwovens industry has been established for many years in Australia and includes all the major nonwoven technologies, such as spunbond polyester, spunbond and spunmelt polypropylene, needlepunch, drylaid hydroentangled, resin, and thermal bonded nonwovens. Nevertheless, the closure of Kimberly-Clark’s line in 2015 has changed the characteristics of the Australian output. The 2020 overall output was still low. No indication of possible new investment in the 2020-2025 time frame was available at the time this report was produced, except in a new meltblown production planned during the sanitary crisis.

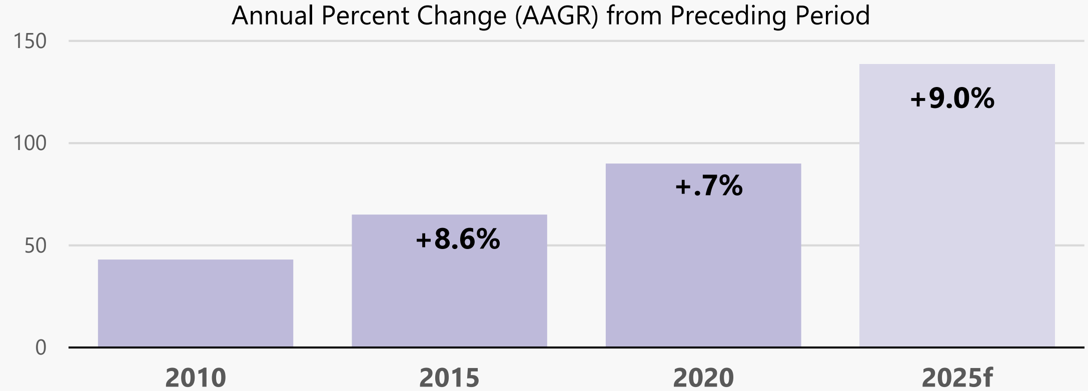
The forecasted 139,000 tonnes nonwovens production in 2025 (Figure II-18) takes into account the evolution in both Africa and Oceania.

Figure II-18

Rest of World Nonwovens Production

In Thousand Tonnes

Annual Percent Change (AAGR) from Preceding Period



Source: ANFA/EDANA/INDA estimates, 2021

PRODUCTION BY PROCESS

This section analyzes the production by web-forming process. The primary method for categorizing nonwoven capacity and production is by the forming process. The nonwoven material forming process can be characterized into four distinct categories:

- drylaid;
- spunlaid;
- wetlaid; and
- airlaid short-fiber.

The spunlaid and drylaid processes accounted for the majority of nonwovens production in 2020, 88% of the tonnage. The share is similar to ten years ago (83%) and at the end of the forecast period (88%) (Table II-5).

In the last ten years, spunlaid production recorded the fastest growth rate (7.7% in average), and increased the most, adding 4.3 million tonnes, compared to the drylaid process adding 3.3 million tonnes. (Table II-4).

Table II-4

Outlook for Nonwovens Production by Web-Forming Process

(Thousand Tonnes)

					2010-2020		2021-2025	
Process	**2010**	**2015**	**2020**	**2025f**	**Δ**	**AAGR**	**Δ**	**AAGR**
Drylaid	4.210	5,705	7,554	8,919	3,344	6.0%	1,366	3.4%
Spunlaid	3,878	5,181	8,132	8,903	4,254	7.7%	771	1.8%
Wetlaid	1,176	1,211	1,570	1,894	394	2.9%	324	3.8%
Airlaid Short-Fiber	534	564	607	724	73	1.3%	17	3.6%
Total	**9,799**	**12,661**	**17,863**	**20,440**	**8,064**	**6.2%**	**2,577**	**2.7%**

Source: EDANA/INDA estimates, 2021

The drylaid process refers to either the mechanical web formation of carding/garneting or the aerodynamic web formation of airformed material which is then thermally, chemically, or mechanically (needlepunch, hydroentanglement, or stitch-bond) bonded.

Spunlaid corresponds to all the spunlaid polymer-based web-forming processes (spunlaid, meltblown and multibeams composites such as SMS, SMMS, SSMMMSS), in addition to other spunlaid processes, such as flashspun and coform.

Wetlaid nonwovens are produced through a process similar to papermaking. The nonwoven web is produced by filtering an aqueous suspension of fiber onto a screen conveyor belt or perforated drum. Many wetlaid nonwovens are made with wood pulp or other natural fibers blended with synthetic fibers or mineral fibers.

Finally, the airlaid short-fiber process refers to a way of laying shortcut staple fibers, typical of a Kroyer/M&J or Dan-Web line, dispersed by air through a forming head to form a continuous web. Although the principal fiber used to produce airlaid nonwovens is fluff pulp, other natural, mineral, and synthetic fibers can be used. Further detailed definitions are included in the definitions appendix.

Each of these web-forming processes can be followed by one or more web-bonding technologies, such as thermally bonding (including air through), chemically/resin bonding, or mechanically bonding (needlepunch, hydroentangle, or stitch-bond).

For instance, while the term “spunlaced” or “hydroentangled” refers to the method of bonding and consolidating a fibrous web, each of the forming processes make use of hydroentanglement. Indeed, several wetlaid-hydroentangled and spunbond-hydroentangled new lines have been built in the last decade, and their possible future impact on the nonwovens industry has been taken into account in their respective web-forming technologies. Nevertheless, drylaid web formation still accounted for an estimated 90% of the world hydroentangled technology’s output in 2020, with many firms producing these materials worldwide, although the development of wetlaid-hydroentangled must be highlighted.

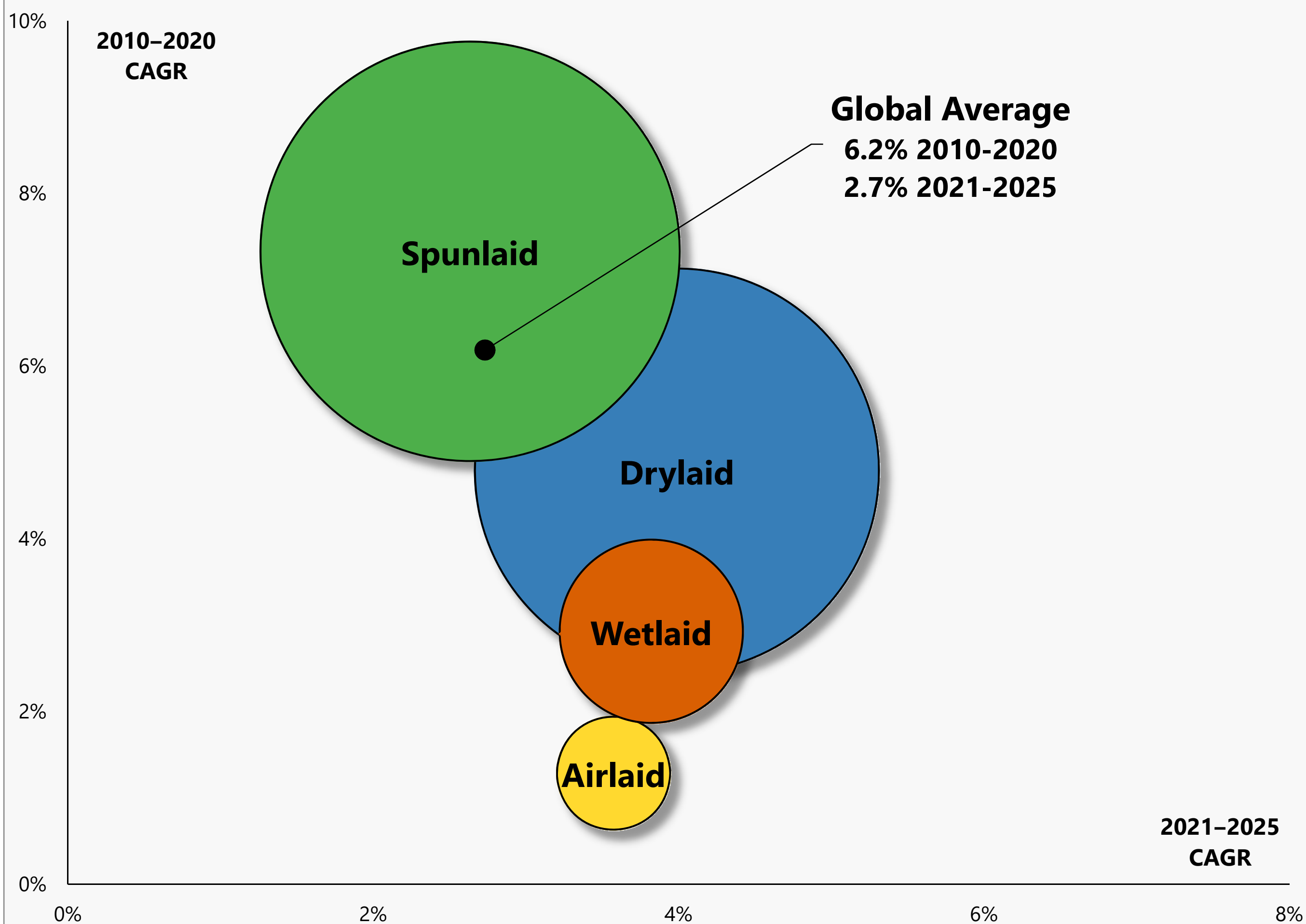
A deeper analysis by bonding process of drylaid nonwovens is provided below. Further detailed definitions are included in the definitions appendix.

Figure II-19 clearly illustrates the size of the two main process, drylaid and spunlaid. The figure also clearly shows the two outliers, airlaid short-fiber and wetlaid. Airlaid experienced moderate growth in the historical period (1.3%), but is expected to increase faster through forecast period (3.6%). Wetlaid, on the other hand, enjoyed a faster annual growth rate (2.9%) in the historical period and is predicted to expand even faster (3.8%) in the forecast period, although, from a much smaller base than drylaid and spunlaid (Table II-4).

Figure II-19

Nonwovens Production by Process Market Sizes and Growth

Historical CAGR (y-axis), Forecast CAGR (x-axis) and
Bubble Size Equal to Tonnes of Production, 2020



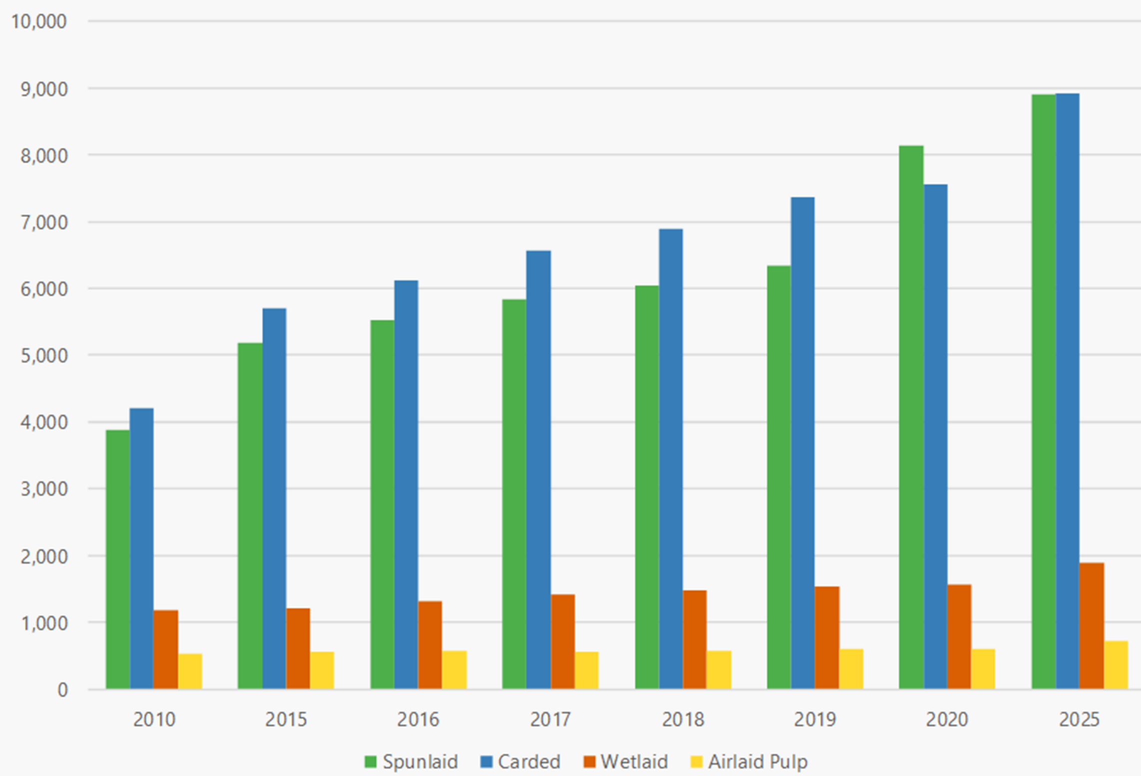
Source: EDANA/INDA Estimates, 2021

Figure II-20 and Table II-4 provide a ten-year historical perspective of the worldwide actual production of nonwovens in tonnes by web-forming process from 2010 through 2020 and a five-year forecast through 2025.

Figure II-20

Global Outlook for Nonwoven Production by Web-Forming Process: 2010, 2015-2020, 2025

('000 tonnes)



Source: EDANA, INDA estimates, 2021

Ten years ago, drylaid nonwovens as a group, which includes thermal bonded, resin bonded, needlepunch and hydroentangled (spunlace) materials, comprised the leading web-forming processes and represented the most important share (43%) of the roll goods produced globally. The combined drylaid technologies' volume grew by 79% between 2010 and 2020, rising from 4.2 to 7.6 million tonnes by 2020. Despite this growth, the combined drylaid forming technologies lost market share, falling to 42% of total world output in 2020.

Concurrently, spunlaid technologies, which include spunbond, meltblown, spunmelt (sometimes referred to as SMS), flashspun and coform, showed considerable growth from 2010 to 2020. These processes together more than doubled their nonwovens output from 3.9 million in 2010 to 8.1 million tonnes of production worldwide by 2020.

Table II-5

Share by Web-Forming Process

(Thousand Tonnes)

	2010		2015		2020		2025 Forecast	
	Volume	Share	Volume	Share	Volume	Share	Volume	Share
Drylaid	4,210	43.0%	5,705	45.1%	7,554	42.3%	8,919	43.6%
Spunlaid	3,878	39.6%	5,181	40.9%	8,132	45.5%	8,903	43.6%
Wetlaid	1,176	12.0%	1,211	9.6%	1,570	8.8%	1,894	9.3%
Airlaid	534	5.5%	564	4.5%	607	3.4%	724	3.5%
Total	**9,799**	**100.0%**	**12,661**	**100.0%**	**17,863**	**100.0%**	**20,440**	**100.0%**

Source: EDANA/INDA estimates, 2019

However, without taking into account 2020 erratic movements which are analyzed in the sub-chapters by bonding process, long term trends of products substitution between technologies can first be drawn.

Spunlaid nonwovens started to gain significant market share in the 1990s with the advancements in spunlaid machinery as purchasers moved away from drylaid nonwovens. Further, technical improvements, particularly in spunbond polypropylene, helped to grow this technology in the 2000s. Over the last fifteen years, new machineries, producing at a higher speed and with lower grammage materials, were made available to the market increasing the efficiency, reducing the consumption of raw materials and adding new properties.

The most important share of the spunbond polypropylene production goes into hygiene products. The rise in market share of spunlaid nonwovens closely mirrors the reverse, or further decline, of drylaid thermal and resin-bonded nonwovens (Figure II-21 and Figure II-23). The major historical factor in the spunlaid technologies' rise and drylaid's share decline was the replacement of drylaid thermal bonded coverstock (top sheet, barrier leg cuff and back sheet) with spunbond polypropylene, due to its lower cost and higher strength. Also, new diaper designs required barrier leg fabrics and cloth-like back sheets, increasing the need for large quantities of spunlaid materials. Through the forecast period, other possible substitutions of drylaid nonwovens by spunbond in hygiene products are expected and have been taken into account. A reverse trend however is not excluded in specific parts of absorbent hygiene products.

This switch from drylaid thermally bonded nonwovens to spunlaid cannot be totally reflected in the data presented here, in which air-through nonwovens are also included in drylaid thermally bonded. Indeed, this bonding technology increased during the period 2010–2020, mostly to fulfil a growing demand in hygiene ADL applications.

Spunbond producers developed suitable, low-cost spunmelt that brought considerable new production capacity to the market to meet the increasing demand and to gain market shares not only in absorbent hygiene products, but also in medical and filtration.

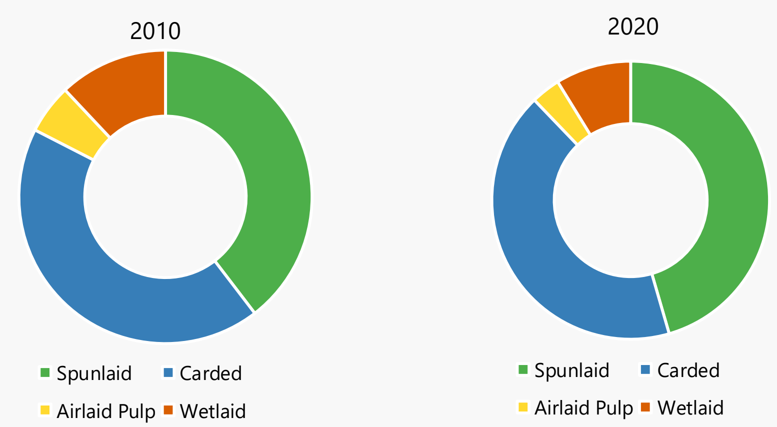
Moreover, in some other markets, such as disposable wipes, some purchasers also moved towards wetlaid hydroentangled and airlaid short-fiber materials, further depressing the overall share of drylaid nonwovens even if a lot of new drylaid hydroentangled lines have been implemented.

By 2025, the world production of drylaid materials in tonnage is expected to be again slightly, higher than spunlaid, mainly due to an expected recovery in durables segments and a reduced demand in medical spunlaid applications compared to 2020 levels. In terms of square meters produced, the spunlaid nonwovens output will continue to be over the drylaid one. According to EDANA statistics which are collected in both tonnes and square meters, very low grammage can be reached in spunlaid nonwovens while the average weight of drylaid materials, in particular in durables applications, is by far a lot higher.

Figure II-21

Share by Web-Forming Process

('000 tonnes)



Source: EDANA, INDA estimates, 2021

Drylaid

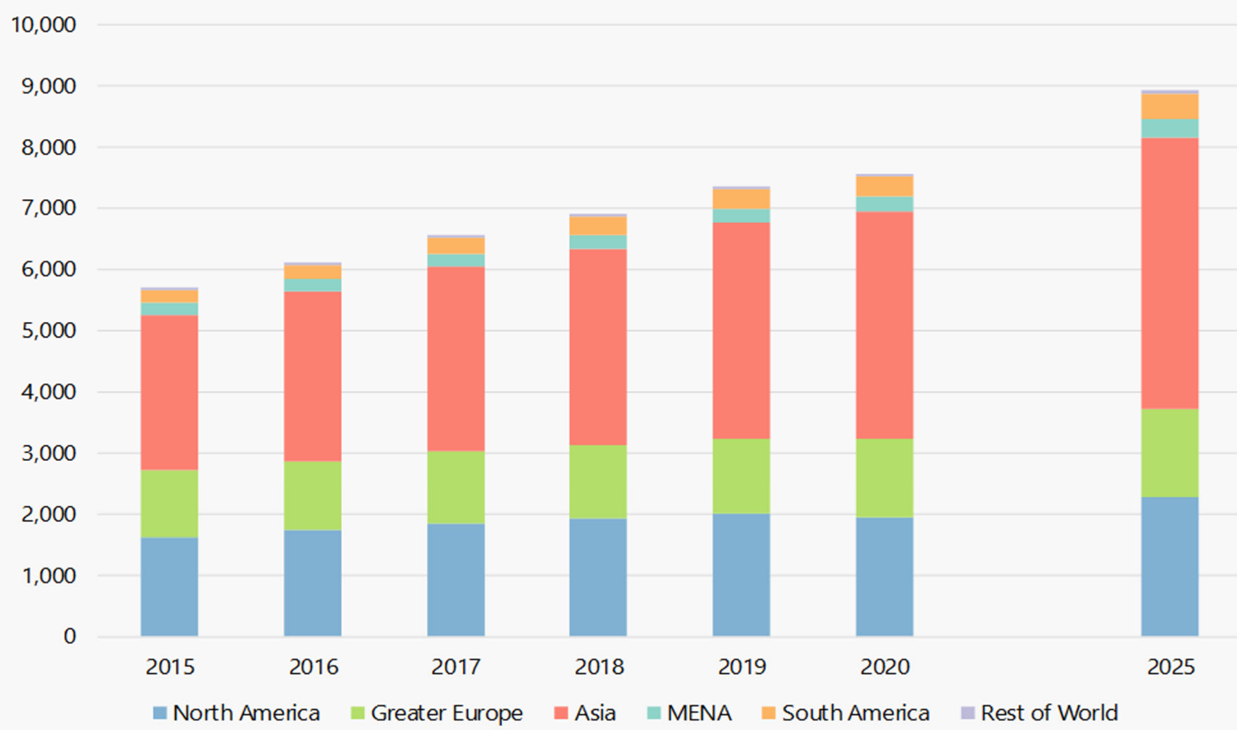
Global drylaid nonwovens output, including all bonding processes, have shown considerable growth over the past decade from 2010–2020, rising 6.0% per year (Table II-4). This represents a growth of 3.3 million tonnes of production during the decade, which is also shown graphically in Figure II-22.

Drylaid production is forecast to rise to about 8.9 million tonnes in 2025, a 3.4% annual increase. This growth rate smaller than the one of the last decade means that in 2025 the global drylaid nonwovens industry will nevertheless produce 18.1% more than in 2020, equivalent to an additional 1.37 million tonnes. Looking at the forecasts by region, one can easily notice that the forecast growth is not homogeneous, with a range of growth rates by region (+3.0% in North America, +2.7% in Greater Europe, +3.5% in Asia, +6.2% in MENA and +4.7% in the South America region (Figure II-22).

Figure II-22

Evolution of the Carded Production by Region: 2015-2020, 2025

('000 tonnes)



Source: EDANA, INDA estimates, 2021

As shown in Table II-6 and Figure II-23, the different types of drylaid nonwovens, classified hereafter by bonding techniques, evolve in distinct ways.

Table II-6

Global Outlook for Drylaid Nonwovens Production by Web-Bonding Process

(Thousand Tonnes)

Process	2010	2015	2020	2025f	2010-2020 Δ	2010-2020 AAGR	2021-2025 Δ	2021-2025 AAGR
Needlepunch	2,028	2,641	3,238	3,937	1,210	4.8%	699	4.0%
Hydroentangle	730	1,347	2.364	2,803	1,633	12.5%	439	3.5%
Thermal & Resin Bond	1,452	1,717	1,952	2,179	500	3.0%	227	2.5%
Global Drylaid Total	**4,210**	**5,705**	**7,554**	**8,919**	**3,344**	**6.0%**	**1,366**	**3.4%**

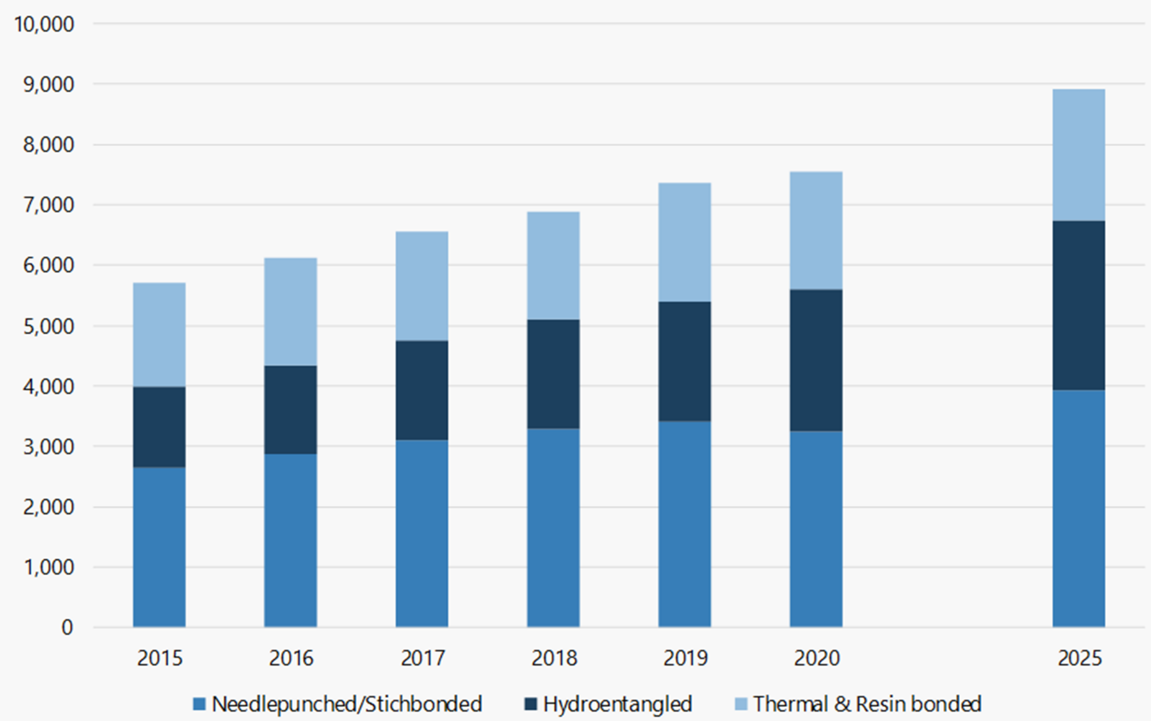
Source: EDANA/INDA estimates, 2019

As shown in Table II-6 and Figure II-23, the different types of drylaid nonwovens, classified hereafter by bonding techniques, evolve in distinct ways.

Figure II-23

Production of Carded Materials by Web-Bonding Process : 2015-2020, 2025

('000 tonnes)



Source: EDANA, INDA estimates, 2021

Drylaid Needlepunch

Needlepunch is generally the first nonwoven technology to be established in an emerging economy. This is due to the technology's versatility and the availability of older, used and less expensive production lines from around the world. Many of these older lines are installed to process natural fibers that are indigenous to the region.

Needlepunch (including stitchbond materials) is certainly the most difficult technology to track on a worldwide basis. Needlepunched nonwovens can be defined differently from one region to another and are often confused with traditional felted materials. Moreover, with probably the most active second-hand market, production lines can easily move from country to country, or even from one region to another. This technology is also certainly the one in which the phenomenon of companies' captive consumption occurs the most. An integrated supply chain can hide the evolution of needlepunch production. This is particularly true in the automotive sector where Tier 1 or Tier 2 suppliers have their own nonwovens production lines.

This report covers only the needlepunched nonwovens made from synthetic, virgin and recycled staple fibers and natural fibers, such as cotton, wool, coir, jute, sisal, flax, or hemp. In addition to these quantities, it is estimated that 300,000–400,000 tonnes of needlepunch materials were produced globally from reprocessed fibers, mostly from used apparel and textiles. These quantities using reprocessed fibers are not included in the fiber volumes within this report.

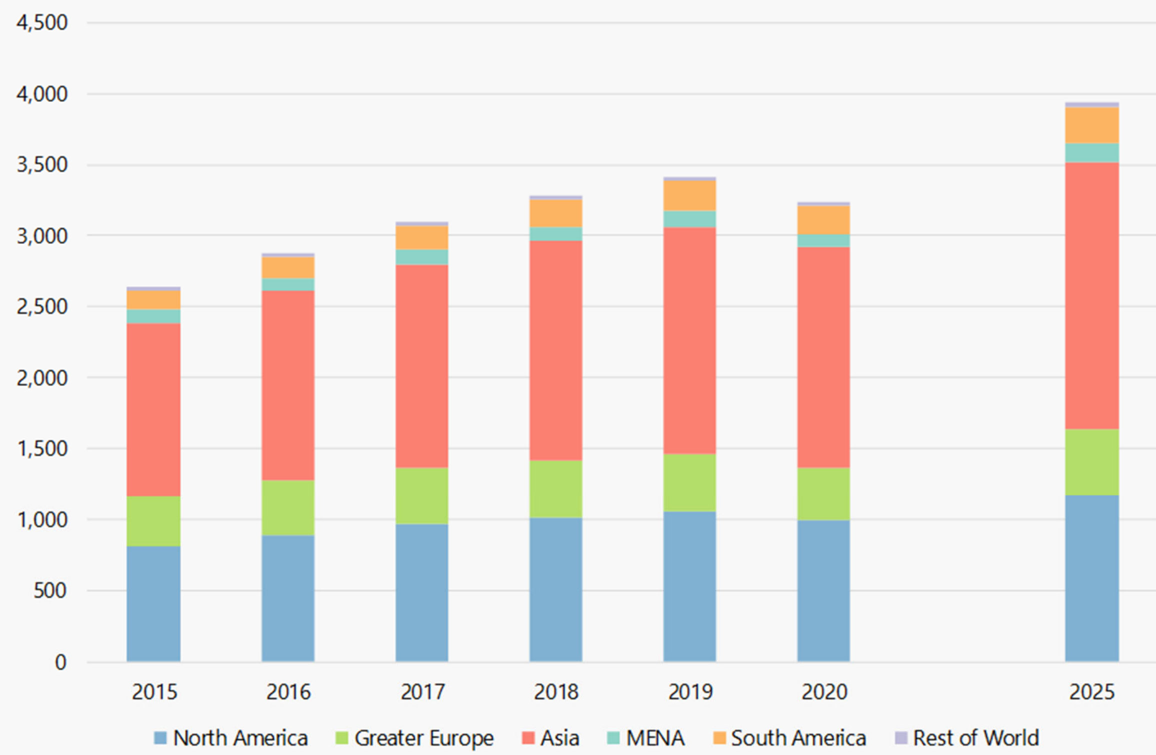
There are many markets for needlepunch materials produced from synthetic fibers. Some of the significant finished markets for synthetic fibers include geotextiles, vehicle carpeting and other interior applications, vehicle exterior components, low cost blankets, coating and laminating substrate, filtration media, synthetic leather, and home and office furnishings, such as upholstered furnishings, indoor/outdoor carpeting and bedding construction materials. Thus, this technology's end markets are almost exclusively durables, although one can find needlepunch nonwovens in specific single-use applications as well, such as in filtration.

In 2020, these typical end-use markets for needlepunch materials were heavily impacted by the successive lockdowns and the global economic downturn. Moreover, in many applications (e.g. in automotive interior), needlepunch average weight can be very high and, once final demand and the required square meters decrease, the impact, valued in lost tonnage, is even greater.

Figure II-24

Evolution of the Carded-Needlepunched Production by Region 2015-2020, 2025

('000 tonnes)



Source: EDANA, INDA estimates, 2021

Needlepunch technology has been a consistent solid performer, growing around 4.8% per year worldwide over the past 10-year period, which is slightly below the overall drylaid growth performance. Table II-6 shows that, 3.2 million tonnes of nonwoven fabrics were produced by the needlepunch technology in 2020 (nearly 200,000 tonnes less than in 2019). It is forecast that an additional 699,000 tonnes will be produced in 2025.

Drylaid Hydroentanglement

As mentioned before, hydroentanglement can follow the different methods of forming webs, but only the volumes of drylaid web formation are, by definition, considered in this chapter.

Hydroentanglement is an increasingly important drylaid bonding technology. This technology accounted for nearly 7.5% of total nonwoven fabric production in 2010. However, by 2020, this technology's share had risen to 13.2%. This technology is forecast to reach 2.8 million tonnes by 2025, accounting again for 13.7% of the total nonwovens production. Moreover, as with spunbond, there is also a trend towards the reduction of the material weight in drylaid hydroentanglement.

Explanations of this impressive growth can be found in this technology's advantages such as softness, cloth-like feel, modest strength and good absorbency. In North America and Western Europe, a principal end market for hydroentangled materials was initially medical, supplying products such as surgical gowns and related apparel, operating room pack parts, sponges, bandages and medical wipes.

As of the late 1990s, a growth of the wipes industry was noted worldwide. The baby wipes industry in North America, Western Europe and Japan had almost reached saturation, and the first generation product had reached maturity. At this time, it was realized that baby wipes were used for more than just cleaning a baby at diaper changing and feeding times. Baby wipes were being used for a variety of other personal and household clean-up chores. From this new understanding of the market, new wipes products were developed to target these emerging markets, and the sales and volume of wipes exploded. An array of new categories of wipes, such as facial wipes, cosmetic removers, antibacterial wipes and automotive cleaners were introduced, with many using hydroentangled materials. Moreover, new products—both wet and dry—revolutionizing the floor cleaning industry were also introduced.

The significance to the nonwovens industry is that these new wipe products, as well as latest generation baby wipes, are made mostly from hydroentangled materials. The success of these floor-cleaning products alone boosted world demand for hydroentangled materials. Dry wipes have always been a significant market for hydroentangled materials, but the expanding pre-moistened wipes market is now the material's most important end use worldwide.

Drylaid hydroentangled nonwovens can be also found in other market segments such as cotton pads, vehicle interior, shoe and leather goods, and filtration.

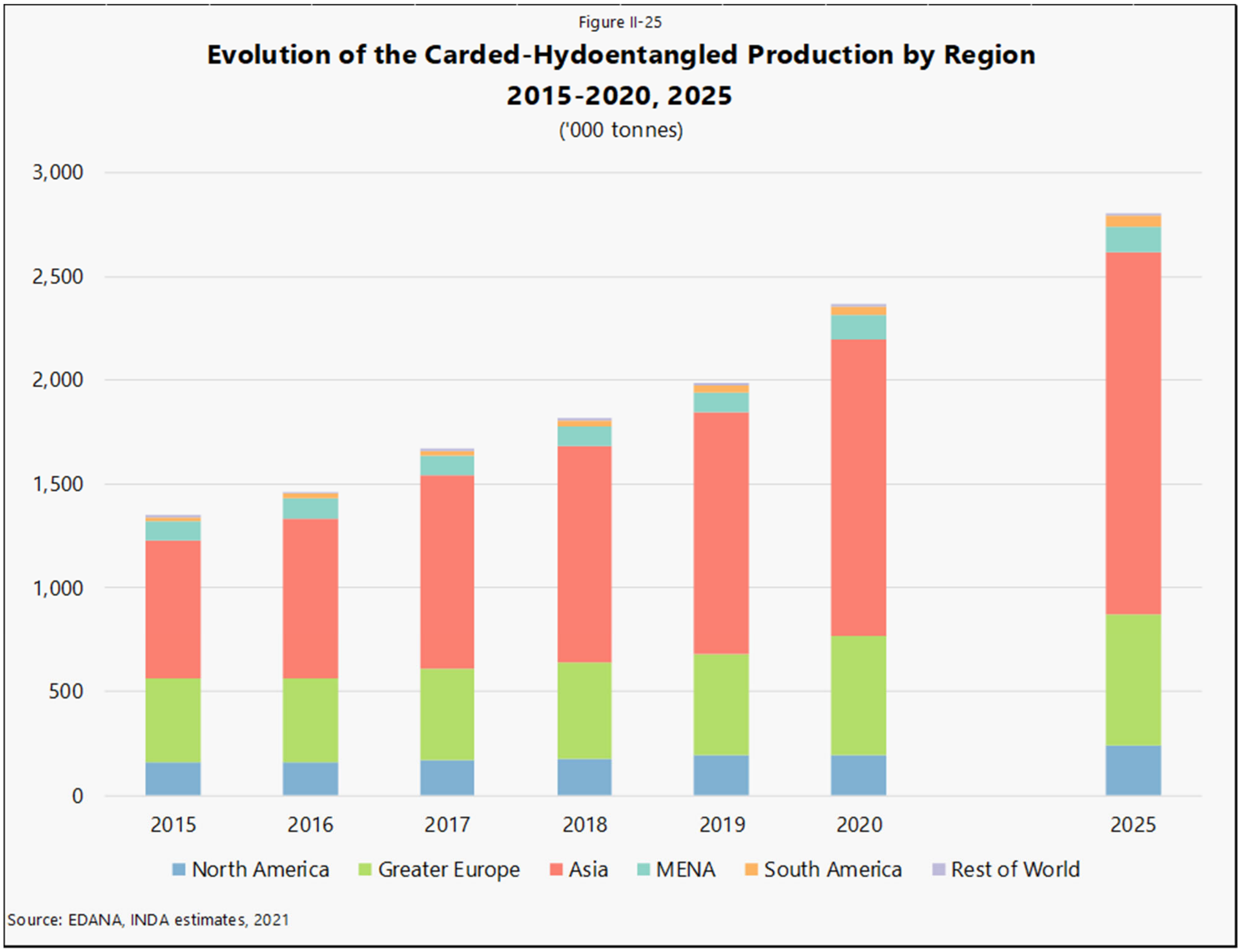
Worldwide production of hydroentangled materials has been multiplied by 3.2 times between 2010 and 2020 (Figure II-25 and Table II-6). While considerable hydroentangled capacity has been added worldwide, supply in some world areas has remained tight with limited capacity as demand continued to expand. It was particularly true during the 2020 pandemic and the intensive utilization of wipes (see Chapter Nonwoven Demand), which explains to a large extent the 19.1% increase, compared to the 2019 level, of the drylaid hydroentangled nonwovens global production.

For the next period, the global production of hydroentangled is expected to record an annual average growth rate of 3.5%, following the average growth of 12.5% in 2010-2020. This demand for this type of nonwovens, in particular driven by its wipes applications, was exceptionally high in 2020. Long-term trends on a global basis calculated on 2019 give a better perspective of the real evolution of this type of materials, with +11.7% in 2010-2019 and +5.9% in 2019-2025.

Nonetheless, the dynamic growth in the wipes segment has changed the profile of the market dramatically during the ten-year period between 2010 through 2020. In 2010, global drylaid hydroentangled production totaled 730,000 tonnes and more than tripled in only ten years to 2,364,000 tonnes by 2020 (Table II-6 and Figure II-25).

In North America, the production of drylaid hydroentangled increased by 5.1% over the last decade (2010–2020) to reach 196,000 tonnes in 2020, but is expected to slow down by 2025 and increase 3.9% on average every year (Figure II-25). In Greater Europe, drylaid hydroentangled production reached 568,000 tonnes in 2020 (+16.7% vs 2019 output), representing an annual average growth rate of 9.1% since 2010 mainly driven by the developments in the wipes markets. Considerable growth happened in Asia, particularly in China, to exceed 1.4 million tonnes in 2020 and a further increase of 4.0%, based on both many new production capacities and higher utilization rates of already existing ones, is expected in this region.

In the future, on a global basis, despite the competition from other technologies such as wetlaid or airlaid, wipes possibly made of different blends of fibers are expected to continue to drive the consumption of drylaid hydroentangled nonwovens. In surgical packs and gowns, hydroentangled products will continue to compete with spunmelt materials.

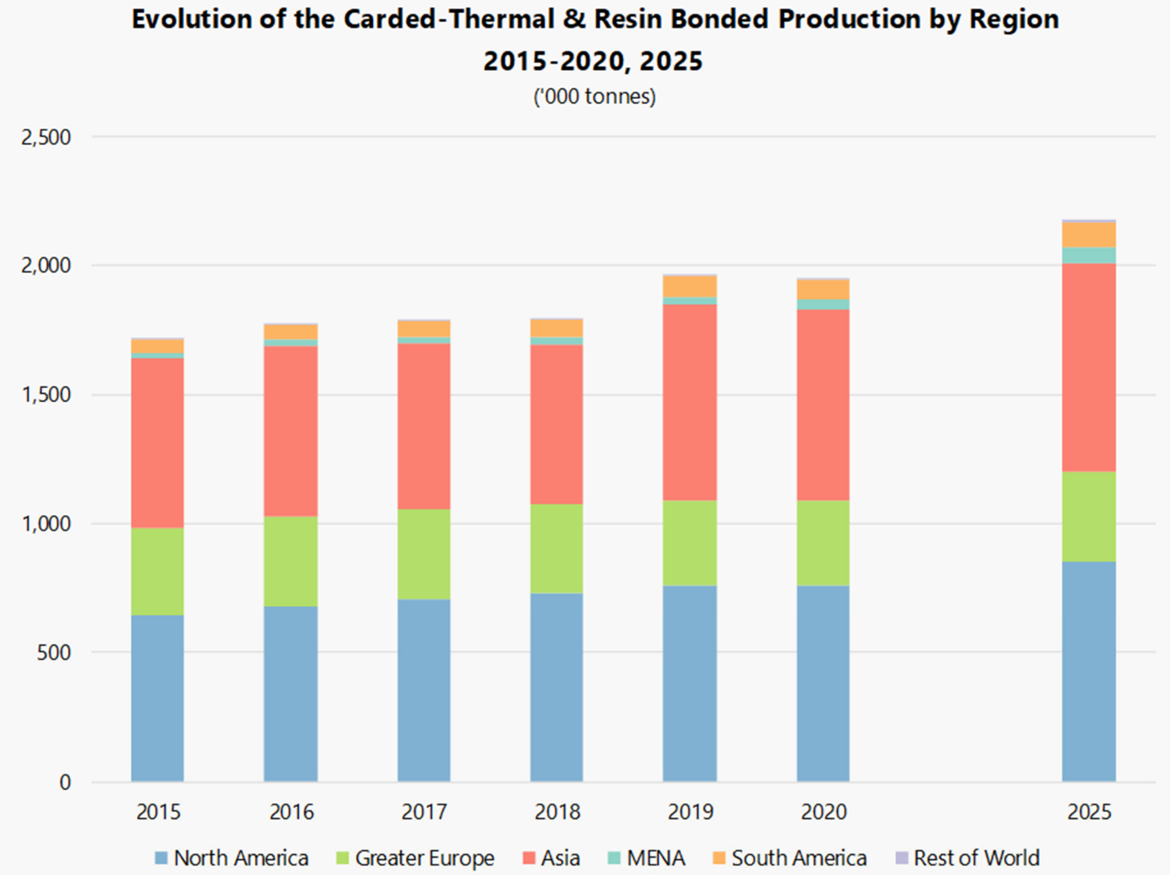


Drylaid Thermal and Chemical Bond

The combined production of drylaid thermal and resin bonded nonwovens globally reached 1,952,000 tonnes during 2020 (Figure II-26). The combined volume of these two technologies grew very little from 2010, when production was 1,452,000 tonnes (Table 11-6).

This represents a limited annual average growth rate of only 3.0% over the last decade. This is slightly lower than the forecast from the previous Worldwide Outlook, where a growth of 3.1% was expected in the 2018–2023 time frame. The main reason was the declining trend observed in resin/chemical bond drylaid nonwovens not balanced by the evolution of the air-through technology.

Figure II-26



Source: EDANA, INDA estimates, 2021

The largest single market for drylaid thermal bonded polypropylene, by far, was coverstock. In the early 1990s, North America and Europe consumed 20-30 billion square meters of thermal bonded polypropylene coverstock materials per year. At that time, the absorbent hygiene products industry began to switch from drylaid thermal bonded polypropylene coverstock to spunbond polypropylene materials. The conversion from drylaid thermal bonded to spunbond polypropylene was slowed somewhat with the introduction of newer, high speed drylaid technologies and the reduction of staple fiber prices. But in spite of drylaid thermally bonded coverstock's pleasing aesthetics and reduced pricing, the lower cost and stronger spunbond materials finally won the day. There are only a handful of thermally bonded production lines dedicated to coverstock in North America and Europe today. The situation in Asia may be different.

Over the period covered by this report, a large part of the growth recorded in this web-bonding category is to attributed to the development in air-through nonwovens and their applications in acquisition and distribution layers and polyester thermal bond lines for the transportation markets, primarily for NVH (noise, vibration, and harshness) materials. Further new investments in this technology have already been announced.

For drylaid resin bonded materials, the global outlook is more difficult to define. Many of its largest end markets of a decade ago, i.e., coverstocks, fabric softener substrates, wipes and building applications, have adopted other nonwoven materials for a variety of reasons, usually lower cost and higher performance. Recently, the demand for drylaid resin bonded material for acquisition and distribution layers in hygiene products has also been declining. While the production of drylaid resin bond materials can continue to increase in some developing markets, its evolution in developed markets is more uncertain as the share of durable segments—in particular in construction and automotive, where growth is linked to the overall economic activity of the different regions—is growing in this technology.

Spunlaid

In 2020, the overall production of spunlaid—all polymer-based nonwovens—represented 45.5% of all nonwovens produced worldwide in tonnage (Table II-5). The same calculation in square meters would give an even higher percentage as spunlaid technologies can produce very lightweight materials. As an example, in Greater Europe where data in square meters are available, spunlaid represented 40.5% of the production of nonwovens in weight, but 65.3% in surface area.

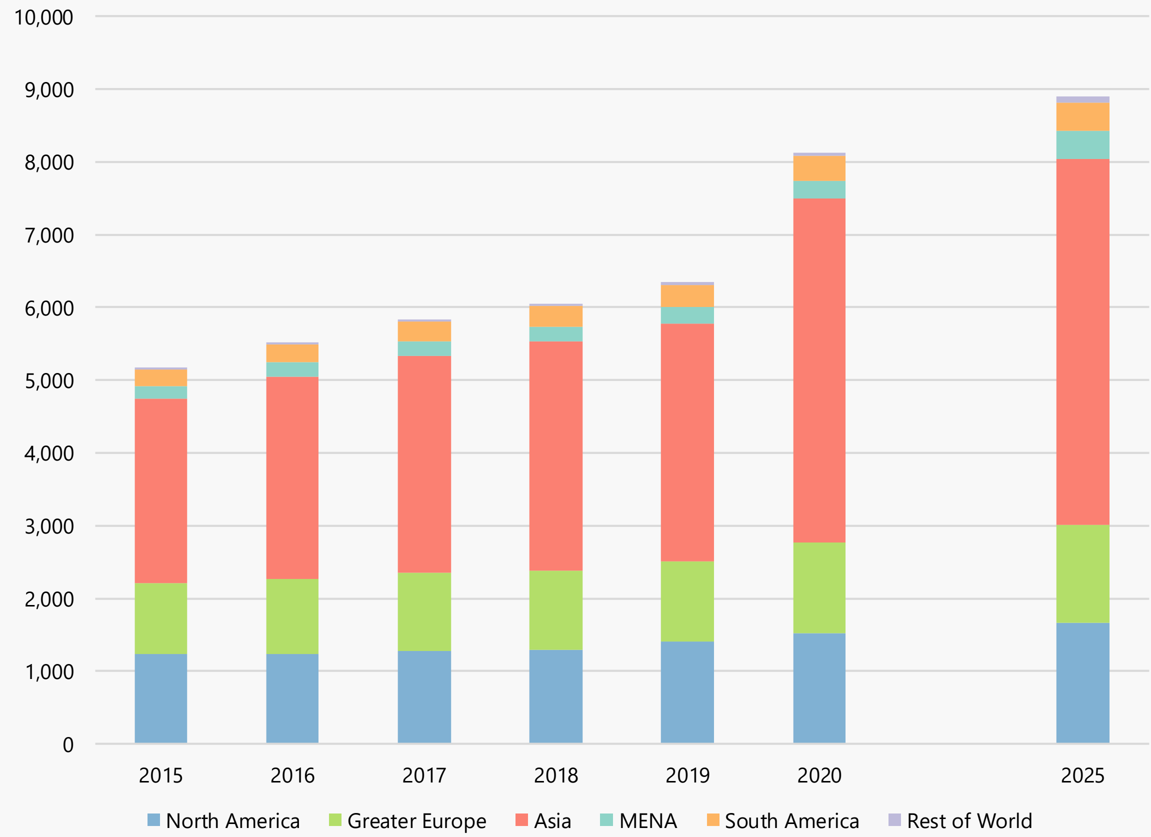
The overall production of spunlaid grew at an average rate of 7.7% annually from 2010 through 2020 (Table II-4). This represents a growth of 4.3 million tonnes of production during the decade. In 2020, the production of polymer-based nonwovens increased by 28.1% (+ 1.8 million tonnes) compared to 2019.

Over the last ten years, all the regions experienced an increase of the production of the spunlaid nonwovens and their respective annual growth rates reached +2.7% in North America, +4.6% in Greater Europe, +12.0% in Asia (China at +13.0%), +2.6% in South America region, +9.1% in MENA, and +5.2% for the Rest of the World (Figure II-27).

Figure II-27

Evolution of the Spunlaid Production by Region 2015-2020, 2025

('000 tonnes)



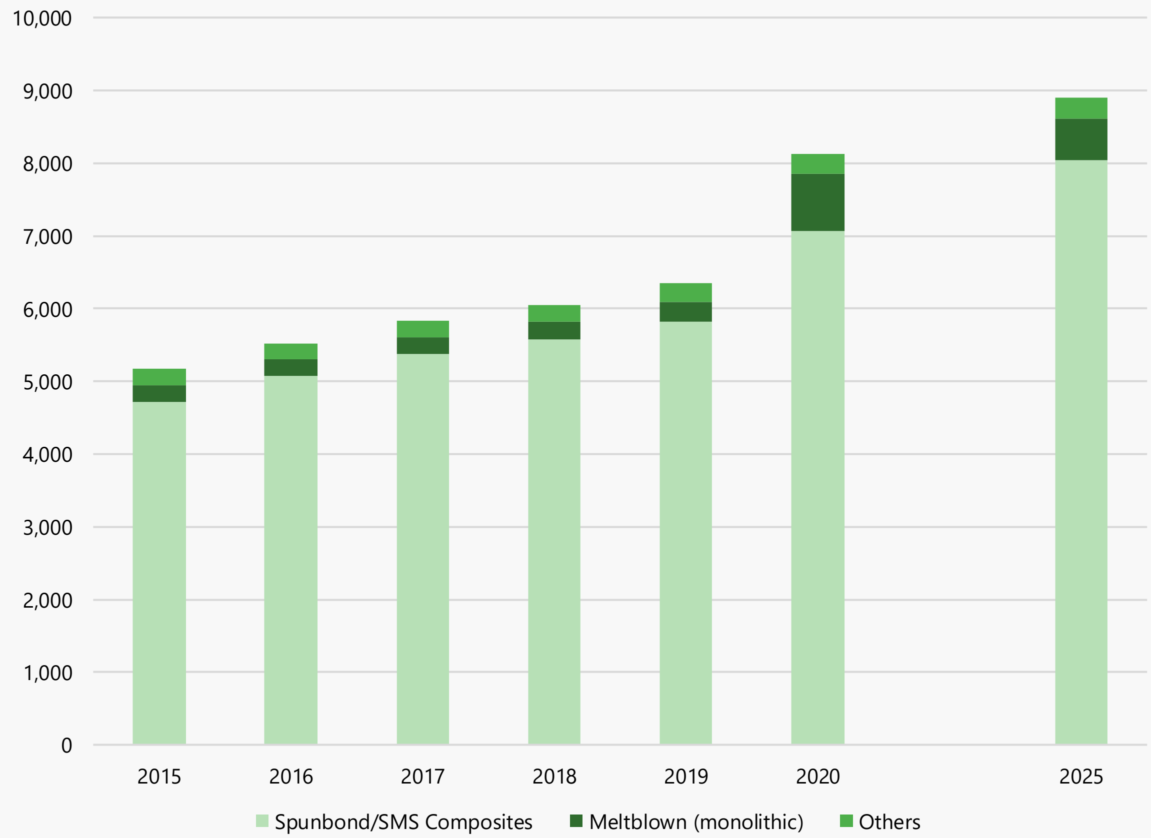
Source: EDANA, INDA estimates, 2021

The spunlaid processes can also be viewed as three sub-categories: spunbond/spunmelt, meltblown and others. Spunbond/Spunmelt includes spunbond lines (single and multibeams) and the different types of spunmelt composite lines (for example, SMS, SMMS, SSMMMSS). Therefore, meltblown referenced hereafter only refers to the output of the stand-alone meltblown lines. Spunlaid products classified in "others" are mainly products combining polymer-based and other materials (for example meltblown and pulp or spunbond and staple fibers) and other processes, such as flash spun. Figure II-28 provides both historical and forecast annual growth rates for the three sub-categories.

Figure II-28

Evolution of the Different Type of Spunlaid 2015-2020, 2025

('000 tonnes)



Source: EDANA, INDA estimates, 2021

By 2025, a further increase of the global spunlaid output is forecast. According to the already announced new capacities and the development of demand to be fulfilled over the next five years, an average annual growth rate of 1.8% is forecast worldwide. This means that around 0.8 million additional tonnes of spunlaid nonwovens will be produced worldwide in 2025, 9.5% more than in 2020.

Again, this forecast growth rate for the next five years can be seen as very conservative, however, is based on a very high level of production and utilization of capacities in 2020. Long-term trends calculation based on 2019 as a starting point, provides similar annual average growth rates in 2010-2019 and in 2019-2025, respectively 5.6% and 5.8% annual growth rates.

Spunbond/Spunmelt

Even though thermal bonding is still by far the most common bonding technology in spunbond nonwovens, other web-bonding technologies (needlepunch, hydroentanglement, or resin bonded) are also used.

Although the development of these technologies has been linked to the absorbent hygiene products and medical markets, the use of this type of nonwovens in durable applications, such as geosynthetics or building construction, should not be underestimated, in addition to filter media.

In 2020, spunbond/spunmelt represented 39.6% of all nonwovens produced worldwide in tonnage. Following the annual average growth of 7.3% observed over the last decade, a further increase of 2.6% per year is forecast for the global production to reach 8.05 million tonnes by 2025 (Figure II-28).

This slowdown of the growth in spunbond/spunmelt compared to the previous period is directly linked to some polypropylene spunbond/ spunmelt markets, such as medical applications (coveralls, shoecovers, head covers, Personal Protective Equipment, face masks), which faced an unusual demand in 2020 and are expected to catch back their long-term trends in the forecast period. On the contrary, many of polyester and/or polypropylene principal markets (such as construction, geotextiles, automotive or agriculture), directly linked to the economic activity and severely impacted by the low final demand in 2020, are expected to grow in the 2021–2025 time frame.

Depending on the targeted applications, different polymers are used in spunbond/ spunmelt production processes. While polypropylene is the favored polymer used by the spunbond/ spunmelt technologies (around 77% of the polymers consumed), polyester (13%) and polyethylene (7%) are the other most often used polymers.

Polypropylene is the resin of choice for spunlaid in hygiene, medical and many durable markets because of its lower cost, attractive aesthetic properties and adequate functionality in both single-use (short-life) and durable (long-life) applications. The consumption of polypropylene was propelled to a large extent by the explosive growth of coverstock using spunlaid materials to replace drylaid thermal bonded coverstock in absorbent products, primarily baby and adult diapers. While the replacement of drylaid thermal bonded and resin bonded coverstock first occurred in North America, Western Europe and Japan, the emerging hygiene markets in Asia, the Middle East and South

America are further driving spunlaid polypropylene's growth. In 2020, polypropylene consumption in spunbond/ spunmelt jumped in medical applications.

Polyester resins are also used by spunbond technology. Polyester is often used in end products in which the fabric will be subjected to heat either in use, such as filtration media subjected to high temperature lubricating oil or smoke dust removal, or in a post-treatment process, such as automotive carpeting that is molded with heat or as carrier of bitumen in bituminous membranes for roofing. Thus, most spunbond polyester is found in long-life or durable end markets, with the exception of disposable fabric softener substrate and materials consumed in disposable filters. Spunbond polyester production lines tend to have lower output than polypropylene ones. While there are some high-capacity spunbond polyester lines, the annual capacity of most of these lines seems to range from about 4,000-8,000 tonnes per year, with the average of 6,000 tonnes. For comparison, a state-of–the-art spunbond or spunmelt production line produces 15,000-30,000 tonnes per year, depending upon the product being made at the time.

Global production of spunbond polyamide (nylon) is low and has remained relatively flat through the years. Polyamide has the advantage of higher strength and good thermal resistance in comparison to similar weights of polypropylene and polyester spunbond materials. Furthermore, the fiber has good resistance to corrosive chemicals and many solvents and thus is commonly found in filtration media. This technology's main disadvantage is its higher cost per kilo. Spunbond nylon's production cost is higher than polypropylene or polyester due to the higher resin costs and production costs. While its cost per kilo is higher, spunbond nylon is often competitive with spunbond polyester or polypropylene on a price-per-square-meter basis, as the user can move to lighter fabric weights due to the polymer's higher strength. Polyamide is not as easy to work with as polypropylene or polyester, and shutting down and restarting a production line is much more difficult, with the ultimate effect of driving up costs. At this time, only three manufacturers worldwide produce spunbond nylon: Cerex, the largest producer of nylon in volume, is located in Pensacola, Florida. Asahi and Unitika are both located in Japan.

Asahi is the only company in the world that produces spunbond rayon (or cupro). Under the Bemcot® and Bemliese® trade names, this unique material is produced from 100% pure "cupro" cellulosic nonwoven derived from cotton linter (the fine fiber that naturally protects and cushions the seed of the cotton plant) which is transformed to pure cellulosic nonwoven sheets in a unique integrated process. These materials are produced in Asahi's

Nobeoka, Japan plant. Volumes have not progressed much beyond the initial annual production capacity of 4,000 tonnes. As rayon is not a thermal plastic fiber, the spunlaid web is bonded by the hydroentangle process. The principal markets for this material are lint-free wipes targeted at the cleanroom market, surgical gauze, premoistened wipes and tea bag filters.

Meltblown

The year 2020 will go down in nonwovens history as the year of the global hunt for meltblown. The main bottleneck in the global supply chain for face masks was a shortage of ultra-fine meltblown filament web, which is the indispensable high-tech filter layer used in all nonwoven masks and is essential for tackling the coronavirus crisis. The nonwovens industry has responded in record time to this unprecedented spike in demand for masks and to ramp up the production of meltblown. In many regions, the rapid reaction by a number of producers in adapting lines and prioritizing mask production has been impressive. Pre-existing meltblown manufacturers added new capacities and new players, with or without experience in nonwovens, invested in new production lines. This largely explains the huge increase in meltblown production in 2020 compared to 2019 (Figure II-28).

However, monolithic, or stand-alone, meltblown materials are found in more than a dozen principal end-use markets. Growth during the past decade was driven by the rapid expansion of several markets, particularly air filtration media (i.e., face masks media, HVAC media), oil sorbents, and wipes. The meltblown media is consumed in the production of disposable face masks used not only in healthcare, but also in general industry, consumer hobby, and home end uses.

Unpredictable events' demand has a direct impact on the production of meltblown materials. Strong public demand as in 2020 or large stockpiles of face masks can be built by public healthcare and government agencies in preparation for any future pandemic or emergency. The same phenomenon of a peak demand for sorbent media, using much heavier meltblown nonwovens, can happen in case of a major oil spill. These jumps in production are, by definition, difficult to predict five years in advance, but can have major impacts on the meltblown materials needed. Moreover, authorities' policies to prevent or no possible shortages in the next crisis plays a major role.

Polypropylene is the dominant resin, accounting for about 95% of monolithic meltblown production. The other leading resin is polyester, of which a principal market is surgical facemask filter media that is subjected to radiation sterilization. Polyethylene meltblown is also produced for filter media as it provides good resistance to organic solvents, degreasing agents and electrolytic attack. Polyethylene has lower working temperatures than polypropylene, is light in weight, resistant to staining and has low moisture absorption rates.

Before the pandemic, the market for monolithic meltblown materials rose around 6.2% per year between 2010 and 2019 (Figure II-28). A significant portion of this expansion was due to the entry of new meltblown products, such as wipes, face mask filter media, acoustic media in vehicles to improve NVH (noise, vibration and harshness), and vacuum cleaner bag liners.

In 2020, the world production of stand-alone meltblown nearly tripled at 789,000 tonnes (it was only 272,000 tonnes in 2019), of which 543,000 tonnes were Chinese products.

Over the next five years the world production is expected to slow down but to stay at a high level (568,000 tonnes in 2025) compared to the pre-crisis level considering that the pandemic will have modified consumer habits regarding the utilization of face masks. Also, additional volumes will be used in other applications such as air filtration, air pollution control, dust and virus filtration, wipes.

Other Spunlaid Nonwovens

Nonwovens made of different spunlaid technologies—other than those previously mentioned—are included in the other spunlaid category. The coform product is not a true monolithic as the material is produced by a unique, proprietary polypropylene meltblown composite technology that introduces fluff wood pulp into the fibrous molten resin stream during production. These materials are used in the company's personal care absorbent products, including baby wipes, and industrial/institutional wipes and floor mops.

The remaining other significant spunlaid technology is the flashspun process, which uses high-density polyethylene as the resin. This is a technology developed by DuPont. In this process, high-density polyethylene is dissolved in a solvent, which initially was Freon. The resin is extruded, and the solvent, which serves as a propellant, rapidly evaporates, causing the individual fibers to essentially explode into a highly fibrillated fiber before they are deposited onto a second layer of a thermoplastic open mesh fabric. The layers are then bonded with a heated calandar to form a composite sheet with high tensile strength. For environmental reasons, Freon was replaced many years ago with another propellant. DuPont claims that over 99% of the solvent is captured by their system, liquefied and recycled in the process. Until a few years ago, only two companies, Asahi and DuPont, used this complex technology. However, DuPont and Asahi reached an agreement whereby Asahi closed down its aging production technology and now represents DuPont's Tyvek® material in the Asia-Pacific region. DuPont—now the sole producer globally— manufactures these flashspun materials at two locations: Richmond, Virginia, and Luxembourg, Europe.

A well-known product made with DuPont's flashspun polyethylene is DuPont's Tyvek® house wrap. This material is attached to the building's exterior prior to installation of the final exterior material, such as siding or bricks. Its function is to lower the heating and air conditioning costs by making the structure more airtight. The material is also used in disposable industrial apparel, non-sterile packaging, furniture and bedding construction and numerous other smaller markets. In 2020, there has been a huge increase in demand by healthcare facilities in Europe and North America, and presumably beyond, for highly protective clothing against microbiological contamination, for obvious reasons. This technology provided a material of choice for such circumstances.

Wetlaid

Wetlaid nonwovens are made on high-dilution forming equipment where various types of fibers are suspended in an aqueous solution and then formed into a web on a screen that drains away the aqueous solution. The nonwoven wetlaid technology typically uses inclined wire machines or rotoformers. This technology is quite similar to the manufacturing of paper, and its development was due to the desire of paper producers to use a wider variety of fibers—uncut, long, natural, synthetic, and mineral fibers, in addition to the usual wood pulp. The means to achieving a uniform distribution of fibers was to dilute the fibers up to ten times more than that required for papermaking.

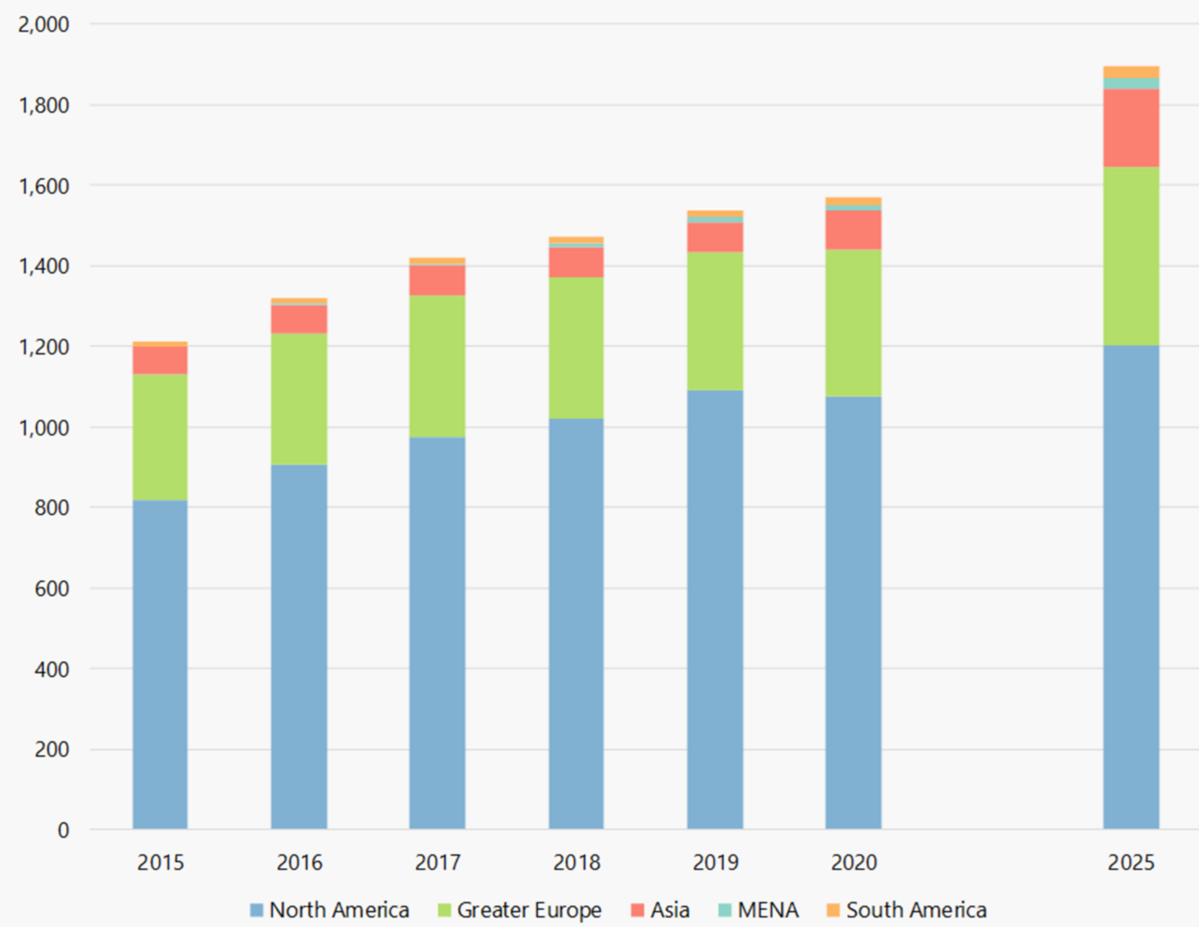
Many types of fibers are used to make wetlaid nonwovens, including cellulose, cotton, glass fibers or other mineral fibers, metal, synthetic fibers (including aramid fibers) and blends of fibers. A wide variety of products are made, ranging from specialty papers to wetlaid micro-glass filtration media to chopped glass for asphalt roofing substrates and a variety of nonwoven end uses composed of synthetic fibers/pulp blends.

The wetlaid process is a fairly mature technology with some of the end markets growing. Wetlaid products typically defined as nonwovens include tea bag media, filter materials, medical barrier fabrics, building construction materials, carpet tiles, specialty wipes, battery separators, coated/laminated substrate as well as several other smaller markets.

During the period 2010–2020, numerous wetlaid lines were installed or upgraded for both “durable” glass products—filtration and electronics markets—and in hydroentangled technologies to produce dispersible material for the single-use wipes market. This industry is located primarily in Europe and North America, but investments have been also made in other regions. North America represented 68.6% of the global wetlaid production in 2020, with 1.077 million tonnes of this type of material (Figure II-29).

Figure II-29

Evolution of the Wetlaid Production by Region
2015-2021, 2025
('000 tonnes)



Source: EDANA, INDA estimates, 2021

However, an analysis in square meters would lead to different shares as wetlaid glass materials used in construction applications in North America are traditionally much heavier than in Europe. Moreover, in Europe, major investments has been made in wetlaid hydroentangled lines to supply flushable wipes with materials at much lower grammage.

On a global basis, wetlaid nonwovens grew from 1,176,000 tonnes in 2010 to 1,570,000 tonnes at the end of 2020 (Table II-4 and Table II-5). This represents an average annual growth rate of 3.8% in tonnage. By 2025, recent investments in this technology will reach higher utilization rates and new investments are also expected in different regions. The world production is expected to be close to 1.9 million tonnes at the end of forecast period, a 3.8% annual growth rate. North American output will propel this technology, as wetlaid nonwovens production in North America is expected to record a further increase of 124,000 tonnes during the next five years.

Airlaid Short-Fiber

Airlaid short-fiber nonwoven webs (called short-fiber airlaid to distinguish them from “airlay” predominantly used as an alternative to carding conventional man-made fibers) can be either resin bonded, thermally bonded (using synthetic fibers) or both, consolidated by heat and pressure (sintered) without bonding fibers or resin or hydroentangled.

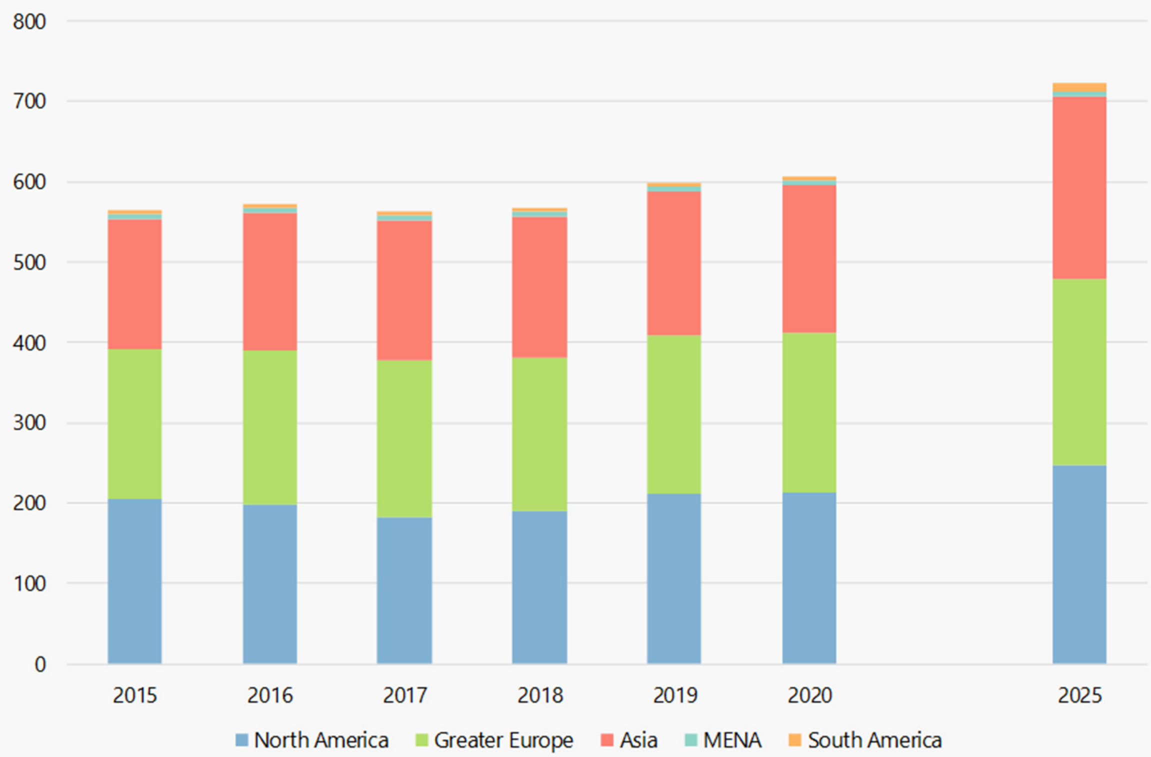
The production of airlaid short-fiber in 2020 reached 607,000 tonnes, only 73,000 tonnes more than ten years before (Table II-4). Thus, this industry grew at an average annual rate of 1.3% from 2010 through 2020. The technology is expected to experience a higher growth rate of 3.6% per year with volume reaching about 724,000 tonnes by the end of 2025 (Figure II-30).

Airlaid short-fiber’s advantages in comparison to a conventional line-formed core absorbent is the product’s consistency, lighter weight with equivalent absorbency performance, thinner cores and simplified production process with the potential for higher line speeds, particularly feminine napkin and pantiliner production line speeds. Most feminine napkin and pantiliner products made in North America and Europe are now made with airlaid short-fiber nonwovens in the core. Airlaid short-fiber material is more expensive on a per kilogram basis compared to conventional fluff pulp cores. But these higher costs are offset to some extent, as the thinner products require less packaging, cost less to transport, and take up less warehousing space. Introduced several years ago—but not used on all feminine napkins—is a 60-70 gsm airlaid that has the purpose of speeding the acquisition and distribution of body fluids throughout the main absorbent airlaid core. The two layers of material total perhaps 250-280 gsm. Airlaid short-fiber cores are also used in training pants and adult diapers, ensuring products that are thin and discreet.

Figure II-30

Evolution of the Short-Airlaid Production by Region 2015-2020, 2025

('000 tonnes)



Source: EDANA, INDA estimates, 2021

The major end markets for airlaid short-fiber materials include wipes (baby, personal, household and industrial), absorbent core materials, tabletop items (napkins, table cloths), medical dressings and oshibori wipes (hot towels). Other product applications include protective-cushioning materials for packaging, filtration media (in the form of glass, metal and/or synthetic fibers), new composite wiping materials and food soaker pads (used under retail chicken packaging, for example).

On a worldwide basis, nearly half (47%) of all airlaid short-fiber is used as core materials in absorbent hygiene products, such as sanitary napkins and pantyliners and, to a lower extent baby diapers, training pants, and incontinence products. Nonetheless, this market share could change in the near future with the major development of fluffless cores.

Absorbent hygiene products manufacturers are always looking for new and more efficient core structures. Cores are made of a mix of fibers (generally fluff pulp) and superabsorbent polymers (SAP). The first represent the matrix to stabilize the second and keep it more or less fixed into the core. Moreover, the fibers have the function to distribute fluid throughout the core for the SAP to absorb. With new developments in diaper design and next- generation SAP, the need for fluff pulp has become less and less important. There is a trend to reduce the usage of fluff and obtain a core made of more SAP. This would lead to a thinner core and less expensive product overall, as the product is thinner. The forecast takes into account that by 2025, this will have some impact on the developed and mature markets, but not yet on the demand from emerging markets.

The wipes industry is the second largest market for airlaid short-fiber. In North America the wipes market consumed 33% of the airlaid short-fiber production in 2020, while in Greater Europe, the wipes market consumed 19.5%. Airlaid short-fiber is well positioned to supply the wipes market, thanks to its attractive properties of softness, absorbency and bulk in comparison to alternatives. Growth of airlaid short-fiber in this market has been exceptionally strong for several years, as the industry expanded and new categories of wiping products were introduced to the consumer, industrial and institutional markets. Baby wipes are the largest wipes segment by volume worldwide.

There is still considerable potential for growth in the use of airlaid nonwovens for tabletop applications, especially in view of technological progress in digital printing, making patterns and decoration for high-end napkins and table linen even more versatile.

However, in Europe, due to the reduced activity in restaurants and other catering, the consumption in this kind of application declined by 28% in 2020, representing only 12% of the airlaid short-fiber 2020 production (it was still 17% in 2019). This decline was compensated by an increase of consumption of airlaid in household wipes and medical applications (e.g. wound care). In North America, it accounted for seven percent of the production in 2020. Estimates for other regions are not available.

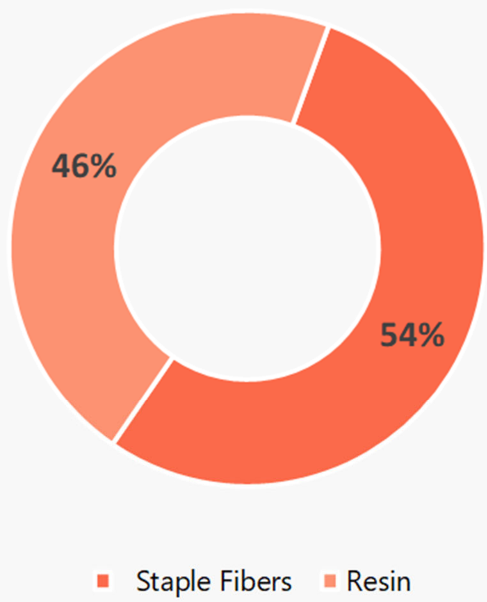
Resin and Staple Fiber Consumption

The figure below (Figure II-31) displays the share of resin (polymer, chips) and staple fiber used in the nonwovens industry, whether in the form of resins or fibers. Staple fiber represented 54% of the material consumed in 2020.

Figure II-31

Share of Resin and Staple Fiber used in Global Nonwovens Industry, in 2020

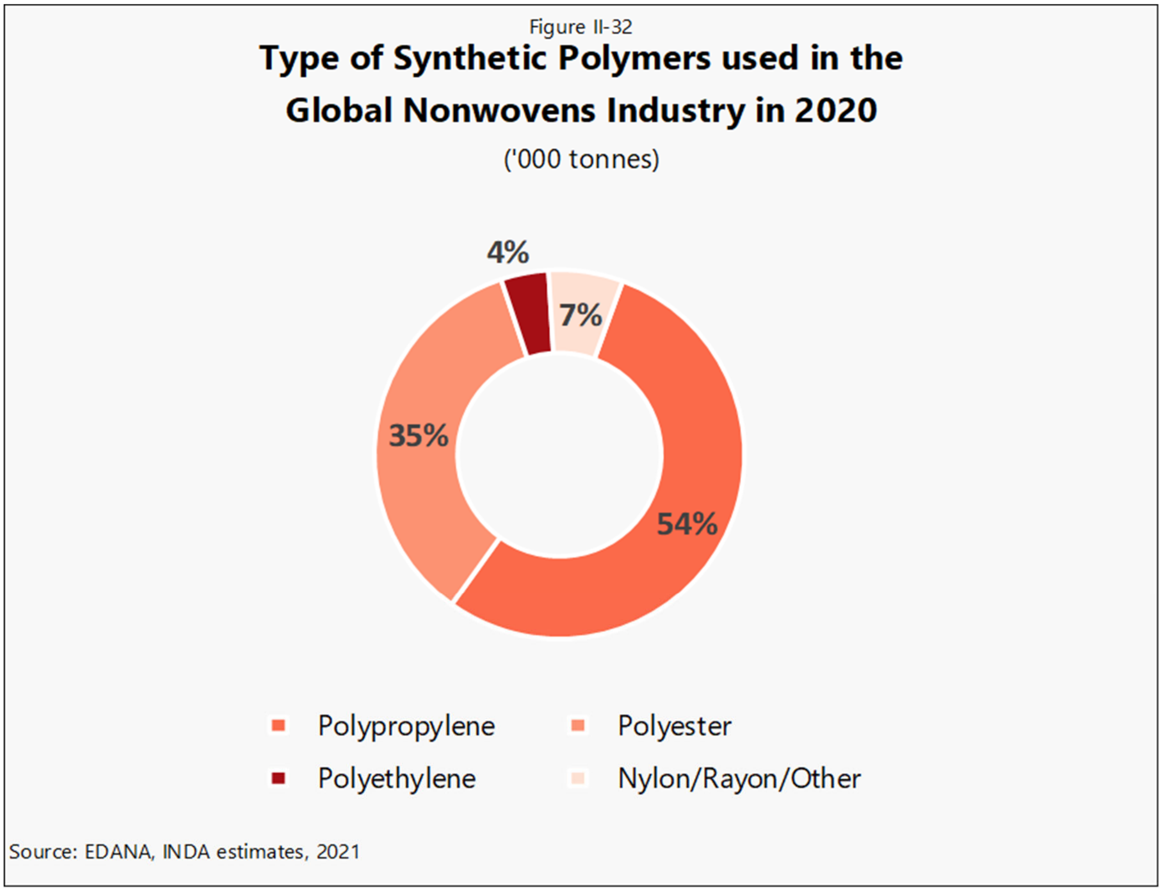
('000 tonnes)



Source: EDANA, INDA estimates, 2021

The next figure (Figure II-32) displays the share of synthetic polymers used in the nonwovens industry, whether in the form of resins (polymer, chips) or fibers. Polypropylene is the most common synthetic polymer, directly followed by polyester.

Raw materials from natural polymers, such as viscose staple fibers, cotton or wood pulp, are disclosed separately in the section



We have included allowances for waste and process losses because, first, INDA and EDANA include real consumption figures in their regional data and, second, to make the data more realistic to help readers from the upstream industries to trace and relate volume statistics throughout the supply chain.

Spunlaid Resins

Resins consumed in spunlaid processes globally in 2020 totaled 8.1 million tonnes (Table II-7). Spunlaid resins are expected to rise by 1.8% per year to reach 8.9 million tonnes by 2025.

Table II-7

Global Outlook for Spunlaid Resin Consumption

(Thousand Tonnes)

Resins	2015	2020	2015-2020 Δ	AAGR
Polypropylene	3,884	6,300	2,416	10.2%
Polyester	708	1,080	372	8.8%
Polyethylene	375	558	183	8.3%
Nylon/Rayon/Other	213	184	29	–2.9%
Total Resin	5,180	8,122	**2,942**	9.4%

Source: EDANA/INDA estimates, 2021

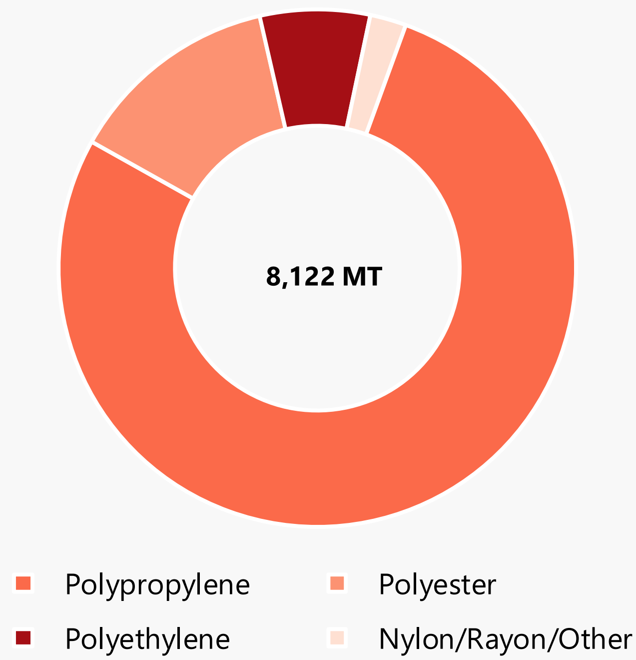
Over the years, polypropylene continued to capture an increased share of the spunlaid volume. By 2020, polypropylene share was about 78% of the global spunlaid market (Figure II-33). Polypropylene has several advantages over other resins, and those advantages continue to drive its growth in new markets and maintain its dominant share position against other resins. Polypropylene has a specific gravity of less than one, lower than competing polymers; therefore, producers attain a higher yield per tonne using polypropylene rather than competing resins. In addition, polypropylene has pleasant aesthetics of softness and pliability, and thus is used widely as coverstock in diapers, feminine napkins and disposable apparel. At the same time, polypropylene has good physical and chemical properties that lead to broad-based market acceptability in durable markets, such as upholstered and bedding construction fabrics, geotextiles, landscape and agriculture markets, to name some of the larger end uses. By 2025, the volumes of polypropylene resin consumed by the global nonwovens industry is forecast to reach around 6.9 million tonnes.

Polyester, the other main spunlaid resin, now supplies about 13% of the market. Global spunbond and, to a limited extent, meltblown production consumed 1,080,000 tonnes of polyester resin in 2020 (Table II-7). Polyester is primarily used in spunbond materials, but a small volume of this resin is consumed in meltblown production. Durables, or long-life markets, are the principal end markets for spunbond polyester, with the exception of fine denier spunbond polyester for fabric softener sheets. The consumption of polyester resin is forecast to rise 1.6% per year to 1.171 million tonnes by 2025.

Figure II-33

Global Outlook for Spunlaid Resins Consumption in 2020

('000 tonnes)



Source: EDANA, INDA estimates, 2021

The use of recycled polyester resin from bottle flakes in nonwovens is increasing globally. According to the information received from its members, EDANA statistics revealed that in 2020, the share of recycled polyester consumed in the production of polyester spunbond reached 39%. Unfortunately, the same detailed information is not available for the other regions.

The consumption of polyethylene, which includes high-density polyethylene used, for instance, in flashspun technology increased from 312,000 tonnes in 2010 to 558,000 tonnes in 2020 and is estimated to grow by 2.0% on average every year until 2025.

The "other" raw materials consumed in spunlaid accounted in 2020 for 186,000 tonnes of various resins, which include bio-polymers, nylon (polyamide, PA), polybutylene terephthalate (PBT), cuprammonium rayon and resins used in bicomponent spunlaid technologies. The use of bio-polymers, for which we also get accurate data only for Europe, is growing but still limited in terms of volumes. Three companies produce spunbond nylon. Output of spunbond nylon is used in several specialty markets, but volume is low, and we do not expect this technology to expand significantly beyond current production levels. Spunbond nylon consumes about 9,000-10,000 tonnes of resin per year. This technology's forecast growth over the next five years will be moderate, around 1,000-2,000 tonnes.

Staple Fiber Based

The consumption of staple fibers by drylaid, wetlaid, and airlaid short-fiber nonwovens production in 2020 was about 9.547 million tonnes as summarized in Table II-8, 2.2 million tonnes more than five years before. Fibers consumption is expected to continue to increase by 3.60% per year and to reach 11.4 million tonnes in 2025.

Table II-8

Global Outlook for Staple Fiber Consumption

(Thousand Tonnes)

Fibers	2015	2020	2015-2020 Δ	2015-2020 AAGR
Polyester	2,614	3,607	993	6.7%
Polypropylene	938	979	41	0.9%
Viscose (Rayon)	682	922	240	6.2%
Bicomponent/Other Synthetics	469	686	217	7.9%
Wood Pulp	1,252	1,727	475	6.6%
Mineral Fibers	808	890	82	1.9%
Cotton/Other Natural Fibers	568	736	167	5.3%
Total Staple Fibers	**7,332**	**9,547**	**2,215**	**5.4%**

Source: EDANA/ INDA estimates, 2021

Polyester staple now accounts for 37.8% of fiber consumed by nonwovens (Figure II-34). Here as well, it would be relevant to make a further split between virgin polyester fiber and recycled polyester fiber, but this information is also missing on a global basis. Nevertheless, EDANA nonwovens statistics show that, in 2020, 33% of the polyester staple consumed in Europe to produce nonwovens are now recycled fibers.

While a large portion of the virgin polyester staple fiber can be attributed to the production of hydroentangled materials destined for the wipes industry, the vehicle sector (carpeting, trunk liners, headliners) consumes large volumes of fiber for heavier weight needlepunch products made of recycled polyester fibers.

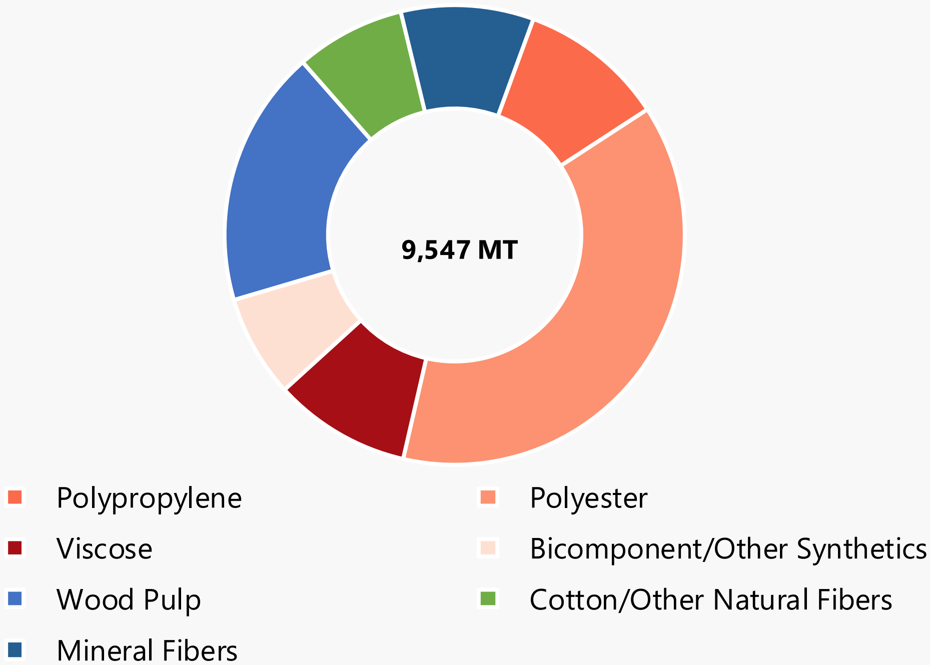
The consumption of polyester staple, both virgin and recycled, is expected to increase to 4.2 million tonnes by 2025, equivalent to 2.9% annual growth. Major single-use or single-use end markets for polyester staple are wipes, filtration, surgical packs and gowns (mostly produced by drylaid-hydroentangled technology). Important durable or long-life end markets include home & office furnishings, geosynthetics, interlinings, and transportation, all markets which are forecast to recover and to expand globally.

Polyester staple volume used in fiberfill—that is not a nonwoven process—applications, such as bedding or apparel insulation, are not included in these figures. Worldwide, polyester used in fiberfill applications is roughly estimated to be at least 900,000 tonnes.

Figure II-34

Global Outlook for Staple Fibers Consumption in 2020

('000 tonnes)



Source: EDANA, INDA estimates, 2021

An estimated 979,000 tonnes of polypropylene staple fibers were consumed by the global nonwoven industry in 2020, accounting for 10.3% of all staple fiber consumed by nonwovens. While polypropylene staple fiber usage has declined in the disposable market, in particular in the demand for drylaid thermal bonded coverstock materials (only partly compensated by utilization of airlaid), this fiber continues to grow in supplying the durable nonwovens market. Most of the large durable end markets for polypropylene staple fibers are needlepunch durables. The major markets that consume needlepunch polypropylene include geotextiles, vehicle components, coating substrate, indoor/outdoor carpeting, blankets, upholstered furnishings and bedding. The worldwide forecast for 2025 polypropylene staple demand is 1.2 million tonnes.

Compared to the 2015 situation, it is estimated that an 240,000 additional tonnes of viscose (rayon) staple were consumed by the global nonwovens industry in 2020, mainly driven by the wipes and medical products industries. The estimate for global consumption of viscose in 2020 was 922,000 tonnes, and consumption of this fiber is forecast to grow to more than 1,144,000 tonnes by the end of 2025.

Nonetheless, the consumption of viscose in wipe applications is quite sensitive to viscose's cost in relation to alternative fibers. Indeed, viscose is normally blended with polyester to produce hydroentangled wipes substrate. The blend for wipes is typically a 50/50 or 60/40 ratio. Viscose used to be the higher percentage of the mix due to its softness and hydrophilic properties. However, viscose staple can be more expensive than polyester. Therefore, the blend ratio can change so that less viscose and more polyester is used as a cost reduction measure. Any significant further rise of viscose's price above polyester could lead to increased substitution and lower viscose's volume outlook from that provided in Table II-8.

Europe's usage of viscose is higher than that of North America's, due to the much higher output of wipes made of hydroentangle materials. In North America, there is a higher proportion of wipes made of airlaid short-fiber and coform technologies, neither of which consume rayon. In 2020 Greater Europe viscose consumption is estimated at 218,000 tonnes, and 162,000 tonnes in North America.

Bicomponent and other synthetic fibers consumed in 2020 were approximately 686,000 tonnes. Bicomponent fibers are increasingly important in nonwovens. There are several types of bicomponent fibers: (a) binder fibers used generally in fiberfill and airlaid short-fiber production; (b) splittable bicomponent fibers that can be divided into micro denier by the hydroentangle process and (c) self-crimping fibers generally consumed by needlepunch production.

The main markets for bicomponent fibers include the acquisition/distribution layers of diapers and feminine sanitary products, airlaid nonwoven binder fiber, needlepunch and fiberfill. All of these end markets are growing and will drive bicomponent fiber consumption. This market is forecast to rise to 799,000 tonnes by 2025.

Below are examples of the various bicomponent technologies and some of the principal producers using each technology:

- **PP Core/PE Sheath Lightweight Fabrics**. This is the most common bicomponent technology and likely the highest tonnage output per year. This bicomponent is used primarily in the production of lightweight nonwovens, less than 35 gsm, for absorbent hygiene products.
- **PP Core/PE Sheath Heavyweight Fabrics**. Heavyweight bicomponent nonwovens range from about 35 gsm to a few hundred gsm. Major end markets of these materials are geotextiles and shoe interlinings.
- **PET Core/PE Sheath**. Often this technology is married with a bicomponent meltblown technology to produce spunmelt fabrics for radiation-sterilizable medical and surgical gowns and patient drapes.
- **PET Core/Co PET Sheath**. This technology is often used in nonwovens destined for filtration, roofing substrate, geotextiles, apparel interlinings and fabric softener substrate. The sheath (about 10% by weight) of this bicomponent fiber is a lower melting point Co-PET. In the through-air bonding process, the heated air softens the Co-PET, and the PET core fibers adhere to one another. The advantage of this bicomponent technology is the higher strength of the fabric after bonding, plus the through-air bonding yields a loftier nonwoven than one bonded by calanders. An advantage of this PET-based material is the finished carpeting is moldable, with heat, to conform to the shape of the car's floor.
- **PET Core/Co PA6 Sheath**. This technology is similar to the previous technology, as a lower melt point copolymer is the sheath and the PA6 (nylon) melts at bonding to increase the fabric's strength.
- **PET/PA6 Sheath**. This is a technology that shows much promise. The polyester/nylon6 is extruded into a segmented pie bicomponent fiber. The bicomponent web of fibers is hydroentangled with a caustic solution. The action of the caustic solution and the force of the water in the hydroentangling process splits the primary fibers into their many segments that are then bonded by hydroentanglement.

While bicomponent nonwovens can be 10-15% higher in cost than spunbond polypropylene or polyester, these nonwovens have several distinct advantages in comparison to nonwovens made of single polymers. These advantages follow:

- Strength. Spunlaid polyester homopolymers are technically more challenging to point bond than say, polypropylene. Thus, spunbond polyester fabrics that are heat bonded using either calander or through-air systems often use a lower melting polymer to improve the bonding strength. One disadvantage of an all-polyester spunbond nonwoven in some products is the harsh feel. But polyester has strength, so producing a fiber with a polyester core and polyethylene sheath will yield a softer fabric while maintaining strength.
- **Softness**. Hydroentangling a spunbond, segmented pie fiber splits the fibers into their component parts and bonds the fibers to yield a strong yet soft fabric.
- **Self-Crimping Fibers**. A side-by-side bicomponent fiber with dissimilar polymers would cause the fiber to crimp upon cooling. Fabrics are loftier with improved softness and possibly improved web uniformity.
- **Recycling**. Bicomponent technology could lead to the recycling of waste polypropylene or polyester resin by putting these recycled materials into the core and sheathing them with virgin resins.

The chief negative of bicomponent technology is the higher waste factor. For example, it is impossible to recycle waste trim of a polyester/polypropylene bicomponent by feeding the material back into an extruder, because these polymers are not compatible.

Wood pulp consumed by airlaid short-fiber, drylaid hydroentangle, spunlaid coform, and wetlaid processes totaled about 1,727,000 tonnes in 2020. Wood pulp consumption is expected to rise to 2,133,000 tonnes by 2025. The gain is a result of the expectation that wetlaid-hydroentangled will gain market shares and airlaid short-fiber nonwoven will continue to replace line-formed absorbent cores on the adult diapers and feminine sanitary production lines. This increased volume does not translate into an increasing pulp demand, rather, a replacement of existing volume. Currently, in the Greater European market, 60,000-75,000 tonnes of airlaid short-fiber are annually used as absorbent cores. In North America approximately 50% of wood pulp is used in the wetlaid process (primarily for wipes and filter media), 27% in airlaid short-fiber, 13% in spunlaid (primarily Kimberly-Clark's coform and Berry Global's Spinlace®) and 10% in drylaid hydroentangle.

Mineral fibers—including carbon, ceramic, carbon and metal fibers—are extensively used in North America. According to INDA figures, of the 890,000 tonnes used by the global nonwovens industry in 2020, the North American industry, alone, consumed 625,000 tonnes, of which 87% was consumed in the wetlaid process. As mentioned before, wetlaid glass materials are much heavier in North America than in Europe, using more glass fibers to produce one square meters.

Glass fiber is made from extremely fine fibers of glass. It is a lightweight, extremely strong, and robust material. Glass fibers have applications in filtration, transportation, construction, electronics, wind energy, industrial, and others. Mineral fibers are often used in the production of wetlaid nonwovens; however, they are also used in airlaid short-fiber and drylaid needlepunch processes.

While global consumption of cotton fiber by nonwoven productions in 2020 was still relatively small, the use of other natural fibers such as jute, flax or hemp is increasing. Both cotton and natural fibers, together, accounted for not more than 7.7% of the fibers consumed in nonwovens. Cotton is also used in many other domestic and personal care products, such as medical sponges, pharmaceutical coil, disposable wipes, tampons, cosmetic pads, beauty coils, jeweler padding and several other miscellaneous products. Although produced from a garnet or carding system, these uses are not generally counted as nonwovens production, except cotton pads made with drylaid hydroentanled machineries.

The consumption of cotton and other natural fibers in proper nonwovens production was 736,000 tonnes in 2020. This consumption in 2025 is forecast to reach about 922,000 tonnes.

INVESTMENT

Global nonwovens production is forecast to rise from 17.863 million tonnes in 2020 to 20.440 million tonnes in 2025. This represents an increase of 2.577 million tonnes of nonwoven material over the five-year period (Table II-4).

It is estimated that, to sustain the forecast industry growth, slightly more than US$4 billion in capital investments will be required to meet the 2025 forecast production volume. This monetary figure includes estimates for new production machinery, erection, material supply systems, machine servicing equipment, and electrical/mechanical hook-ups. It does not include site preparation, buildings, peripheral costs normally associated with a new line such as employee training, power supply to the site, material handling equipment, start-up qualification time and waste, finished goods storage, working capital and similar items.

In 2020, on a global basis, very high utilization rates of production capacities were experienced in some technologies (spunbond, meltblown, drylaid-hydroentangled) and, on the contrary, capacities were underused in several other technologies. Considering a possible nonwoven overcapacity in some markets/processes and the expected impact of lines which are starting or have been announced, it is challenging to define the new investments that will be needed in the different regions.

However, production forecasts shown in this report take into account already announced plans of expansion. Better utilization rates of existing capacities was also considered. Additionally, some of the older lines can be either used to supply other market segments or, simply, be deemed obsolete and dismantled (or potentially shipped to developing markets). Line movements, closures or upgrades are obviously difficult to predict at our level as this is part of every company's strategy.

The table below (Table II-9) shows the amount of the investment—or increase in capacity utilization—needed by nonwoven technology. While, the table on the following page (Table II-10), summarizes where the investments will be required. Comments made in this forecast capital investments by region are in regards to new capacity needed to reach the forecast production compared to the current output and do not take into account possible line closures or lines' movements between regions. Moreover, depending on the technology and the machinery supplier, the possible output of one line can also vary a lot.

Table II-9

Forecast Capital Investments by Technology, 2021–2025

Technology	Forecast Production Increase 2021–2025 (Thousand Tonnes)	Approx. Capital Required Per Tonne of Output (US$ equivalents)	Approximate Total Capital Required (US$, millions)
Spunlaid			
Spunbond/Spunmelt	981	1,000-1,500	1,226
Meltblown (Monolithic)	–220	3,500-6,000	117
Other	10	2,500-3,000	28
Spunlaid Total	**771**		**1,371**
Drylaid			
NP/SB	699	750-1,750	874
Hydroentangle	439	1,000-2,000	659
Thermal/Resin Bond	227	1,200-2,400	408
Drylaid Total	**1,366**		**1,942**
Wetlaid	**324**	1,200-3,000	**680**
Airlaid Short-Fiber	**117**	1,500-2,500	**233**
Total (Estimate)	**2,577**		**$4,109**

Source: EDANA/ INDA estimates, 2021

As explained in the Outlook for Nonwovens Production by Web-Forming Process table (Table II-4), future developments and investment needs will be different by process and from one region to the other (Table II-3). Therefore, it is estimated that US$1.942 billion will be in the drylaid area (46% share of the investment), US$1.371 billion in spunlaid (32%), US$680 million in wetlaid (17%) and US$233 million in airlaid short-fiber (6%) (Table II-9). This is significantly different than last issue of this publication, formerly the Worldwide Outlook for the Nonwovens Industry, when the spunlaid share was of investment was estimated at 64%. This is a result of the significant increase in 2020 spunlaid production to meet the pandemic-related material demand. In terms of regional capital investment needs, just over a third (37%) would be in China, followed by North America (24%), Greater Europe (16%), Other Asia, less China (9%), Middle East & North Africa (8%), South America (5%), and the Rest of the World (2%). This is also significantly different from the previous report when China's share of investments were estimated at 58% followed by North America at 18% and Greater Europe at 8%.

Table II-10

Forecast Capital Investments by Region, 2021-2025

Region	Forecast Growth ('000 tonnes)	Comments
North America	609	Significant investment has already been announced in spunbond/spunmelt with 8 lines announced and another 3-4 likely to start up as well. Meltblown will be relatively neutral with significant capacity added in 2020 (22 lines), additional lines being added in 2021 and some line closures in 2021-2022. Drylaid will continue to expand, adding additional needlepunch (~17), thermal/chemical (~11) and hydroentangle (~5 lines). Wetlaid is forecast to add a line a year and airlaid short-fiber 2 to 3 lines.
Greater Europe	405	Region could need new investments – spunmelt polypropylene and polyester will require 5-10 lines, drylaid air-through (4-8 lines), drylaid hydroentangle (4-6 lines) and wetlaid (1-8 lines) beside higher utilization rates of existing capacities (drylaid-needlepunch, drylaid-thermal/chemical, airlaid short-fiber, meltblown).
China	837	Huge investments in drylaid-hydroentangled which came on stream end of 2020 and 2021 will impact the supply. Some meltblown lines to stop after the pandemic. Important investments expected in drylaid air-through thermal bond (5-10 lines), needlepunch (10-20 lines). Continued expansion of spunlaid polypropylene and polyester (20-25 production lines). New investments expected in wetlaid (5-10 lines).
Japan	42	After investing abroad, companies to restart investing locally. Little needed to expand domestic production in fiber-based nonwovens, with upgrade investments being possibly sufficient. Spunlaid production not yet back at its 2015 peak, despite improved utilization rate and new investments (1-3 lines).
Other Asia	241	Forecast investments in additional spunlaid (10-15 lines). Growth in drylaid needlepunch, partly linked to higher utilization rates than in 2020, and hydroentangle. Possible development in drylaid air-through and wetlaid. Growth areas will be mainly India, Indonesia, Malaysia, Thailand and Vietnam.
South America	147	Spunlaid capacity will be added (~4 SB/SM lines) in addition to demand being meet by improved operating rates and smaller and older lines in operation now will be replaced by larger and faster lines. Another 1 or 2 meltblown lines will be added to meet the demands in filtration and transportation. Moderate expansion across the drylaid processes: ~8 needlepunch lines, ~3 hydroentangle lines and ~6 thermal/chemical lines. Potential for another wetlaid line, perhaps with hydroentanglement and another airlaid short-fiber line.
MENA	246	Mostly in spunlaid polypropylene, polyester and bico (8-11 lines). Expect growth in drylaid needlepunch (3-5 lines), hydroentangle (1-2 lines) and air-through (1-3 lines). Region should also see need wetlaid-hydroentangled (1-3 lines) for wipes.
Rest of World	49	Possible investment in spunlaid (1-3 lines) in Africa (outside South Africa).
Total	**2,577**	

Source: EDANA/INDA estimates, 2021

The production of North American nonwoven materials is estimated to increase by 609,000 tonnes during the 2020–2025 period, requiring an investment of US$994 million. As North America is forecast to experience strong growth across almost all end uses, all the web-forming processes will require investment. The drylaid process are forecast to account for 45% of the investment (US$451 million). Some of this demand will be met by current underutilized capacity. The spunlaid process are forecast to expand on average 28,000 tonnes a year through the five-year forecast period, requiring an investment of US$214 million. The majority of this need will be meet by new capacity investments as the spunbond/spunmelt market went through a couple years of capacity rationalization, just prior to the pandemic. Significant capacity will be added to meet the ever growing needs of the filtration, which there is not a contraction in meltblown forecast.

Investments in Eastern Europe, Turkey and Russia are captured in the Greater Europe statistics. The capital investment in Greater Europe is forecast to be about US$678 million between 2020 and 2025, with drylaid accounting for 37% of the investment.

By the end of 2020, China produced almost 40% of the world demand for nonwovens. China's growth is expected to continue, but at a slightly slower pace (2.3% per year) based on a significant increase of production in 2020 (+31.4% compared to 2019). All technologies output will be increasing, except meltblown. The Chinese production of meltblown, which exploded in 2020 (+729%), will drop and this explains the decrease of meltblown on a global basis (Table II-4). Indeed, with new capacities starting in other regions, the supply/demand pressure decreased and some production capacities in China had already stopped at the time this report was released. Nevertheless, it is estimated that, by 2025, 39% of the global nonwovens will be still produced in China. To meet this higher volume—1.08 million tonnes without taking into account the decrease in meltblown—the country will invest the equivalent of US$1.547 billion. Actually, this amount may be slightly overstated as some of the Chinese domestically built production lines are less expensive in comparison to the western technologies the estimates are based upon, in addition to the greater utilization of existing assets.

As mentioned earlier, during the previous period, Japanese investments in new nonwovens capacities have been made mainly outside Japan. In the 2021-2025 time frame, Japanese companies are expected to invest again locally.

The Other Asia market's main producers are South Korea, Taiwan, Thailand, Malaysia, India and Indonesia. A large portion of the US$390 million investment capital needed for

Other Asia is expected to go towards the industries in India, Indonesia, Thailand and Vietnam. India's nonwovens industry is still relatively small in relation to their population size, although this country produced about 1,386,000 tonnes of nonwovens in 2020, roughly 20% of the Chinese output with a similarly sized population. It is always difficult to forecast the growth of a developing market as it is not unusual for the industry to go through a period of exponential growth as witnessed in not only China, but also in Brazil, Mexico, and MENA. It has been the case for India, with double-digit average annual growth rates between 2010–2020. Nevertheless, forecast production growth is expected to slow down in the 2021–2025 time frame, but again based on a non-typical 2020 year.

Countries like Vietnam/Nepal/Bangladesh must also be mentioned, as these countries' labor cost advantage and political stability are major advantages. There are manufacturers of absorbent products in Vietnam, and they may need to be supplied locally in the future. Nevertheless, there are still question marks about a possible emerging nonwovens industry due to their proximity to other growing suppliers like China, India, Malaysia or Thailand.

Other smaller Asian countries will see the emergence of nonwovens capacities too, such as Turkmenistan, Uzbekistan, Kazakhstan. An undefined, but probably very limited, production of nonwovens (especially drylaid-needlepunched) could also potentially exist in countries like North Korea or Mongolia.

Between 2010 and 2020, there have been considerable nonwoven investments in Egypt and Saudi Arabia. Depending on the evolution of the production in other regions (such as Africa or India), further planned expansions in these two countries might be needed but are difficult to estimate. During the forecast period, Iran could finally emerge as a fast-growing nonwoven market like Turkey did in the past decades, but current political uncertainties, which had already postponed or canceled new nonwoven investments during the previous period, led us to a conservative forecast for this country. An estimated US$332 million could be invested in the overall MENA region.

South America is forecast to require another 147,000 tonnes of nonwoven material of which around 46,000 tonnes is of spunlaid materials and 85,000 of drylaid materials. To meet these needs, it is forecast an additional US$67 million will be needed in spunlaid technologies and another US$153 million for the three staple fiber processes.

The Rest of World takes in Australia and the rest of Africa (except North Africa countries considered in MENA). With the exception of the country of South Africa, there is still at the moment minimal nonwoven production in Africa compared its local growing industries in absorbent hygiene. Therefore, we consider that by 2025 new spunlaid capacities will be required to sustain the development of the local supply chains.

III. NONWOVEN DEMAND

This section presents end-use production data for the global nonwovens markets for 2010, 2015, and 2020, and a forecast for 2025. At the basic level, the markets can be defined as single-use (short-life) and durable (long-life) applications.

Disposable applications—that is products designed to be replaced—are composed of four main end-use markets:

- absorbent hygiene;
- wipes;
- filtration; and
- medical.

Durable applications are those designed to have an average useful life of at least three years (based on the economic definition of durable goods). The durables main end-use markets are materials for:

- transportation;
- building construction;
- home and office furnishings;
- geosynthetics; and
- apparel.

The "other" category includes both disposable and durable products.

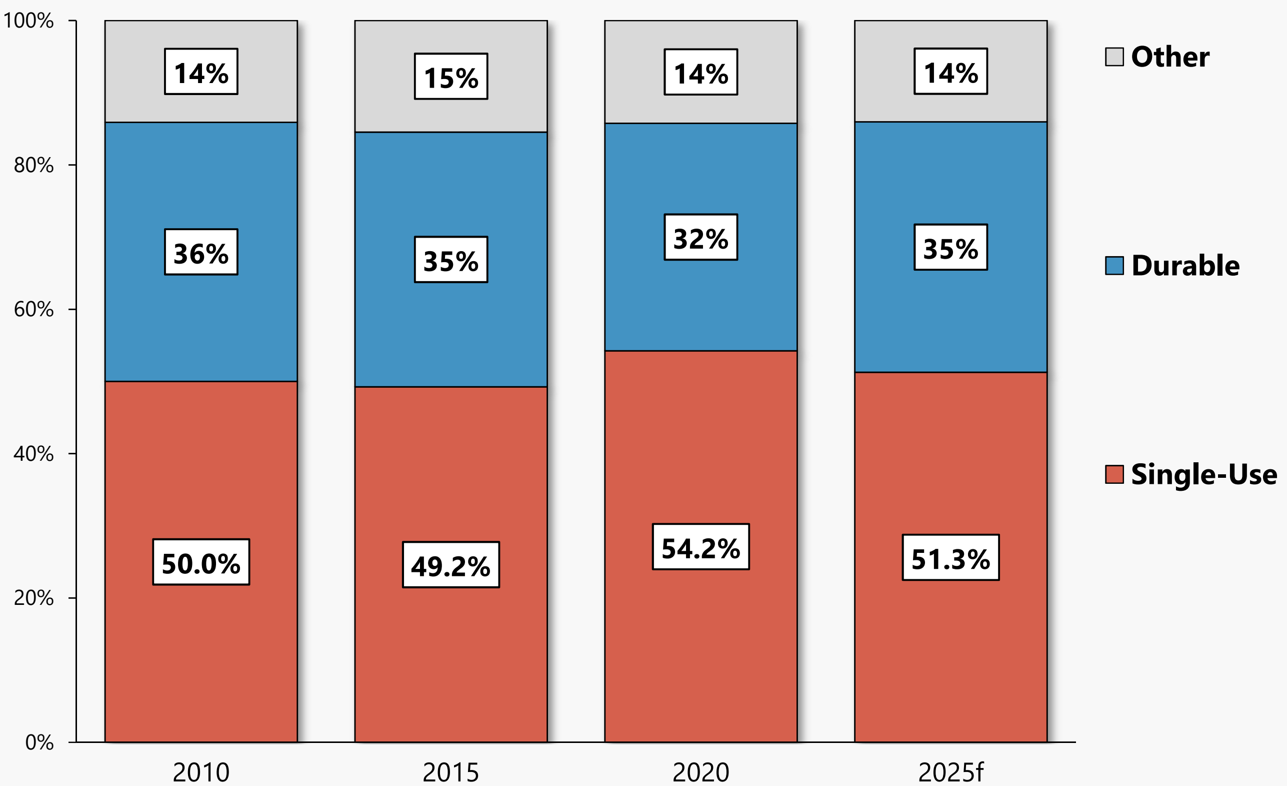
The global nonwoven production is an estimation of the material produced in a region for the end-use items (for example, a baby diaper or passenger car) and the amount of nonwoven material within each end-use item. It should be noted production includes not only material used in the region, but also material that is exported to be consumed in another country. For example, the BMW Manufacturing in Spartanburg, S.C., on average exports 70% of their vehicles produced (218,820 vehicles with an export value of more than $9.8 billion in 2020). Each of these vehicles contain a significant amount of nonwoven material, the majority of which is produced in the North America region, yet then exported. This is especially significant for China's production, as through the last five years, on average China typically exports a fifth (19.4%) of its production. Additional information on China's nonwoven is in the International Trade Flows section.

In 2010, the single-use end-use applications represented 50.0% of the global production; by 2015 that number shifted slightly to 49.2%; however, as a result of the nonwovens industry's response to the COVID-19 pandemic, the share of single-use soared to 54.2%. It also should be noted at this time, many of the industries that use durable applications, were completely shut down for a few months, notably building and vehicle construction, and other end uses, primarily those supplying single-use products such as wipes and face masks, were operating full-out. This will be a continuing theme through this section, as 2020 is somewhat of a data anomaly. Additionally, producers were challenged by workforce and transportation issues. Going forward, the share returns to its historical share, moving to 51.3% in 2025. The figure below displays these tonnage shares of production through the historical and forecast periods (Figure III-1).

Figure III-1

Global Nonwovens Market by End Use

(Tonnes)



Source: INDA/EDANA/ANFA estimates, 2021

Production growth through the historical period (2010–2020) varied across each of the individual end-use categories as each has its own unique demand drivers, in addition to the macro drivers discussed in the first section. While some end uses are more impacted by population growth and rising incomes (typically the single-use end uses), others are impacted by the health of the economy and taking share from other competing materials (typically the durables end uses). Further, each may be at a different development stage and/or penetration rate within a specific global region.

Absorbent hygiene is by far the single largest end-use category accounting for a nearly a quarter (19.5%) of the global production in 2020; this is down from a quarter (26.6%) in 2010. Due to the need for protective medical apparel, the nonwoven production for the medical end use skyrocketed from representing just six percent (5.5%) of the production in 2010 to 13.9% of the production in 2020, moving it to third, just behind the other category (14.2%). The other category includes numerous end uses, both single-use and durable (Figure III-2, Table III-1, Figure III-3 and Figure III-4A).

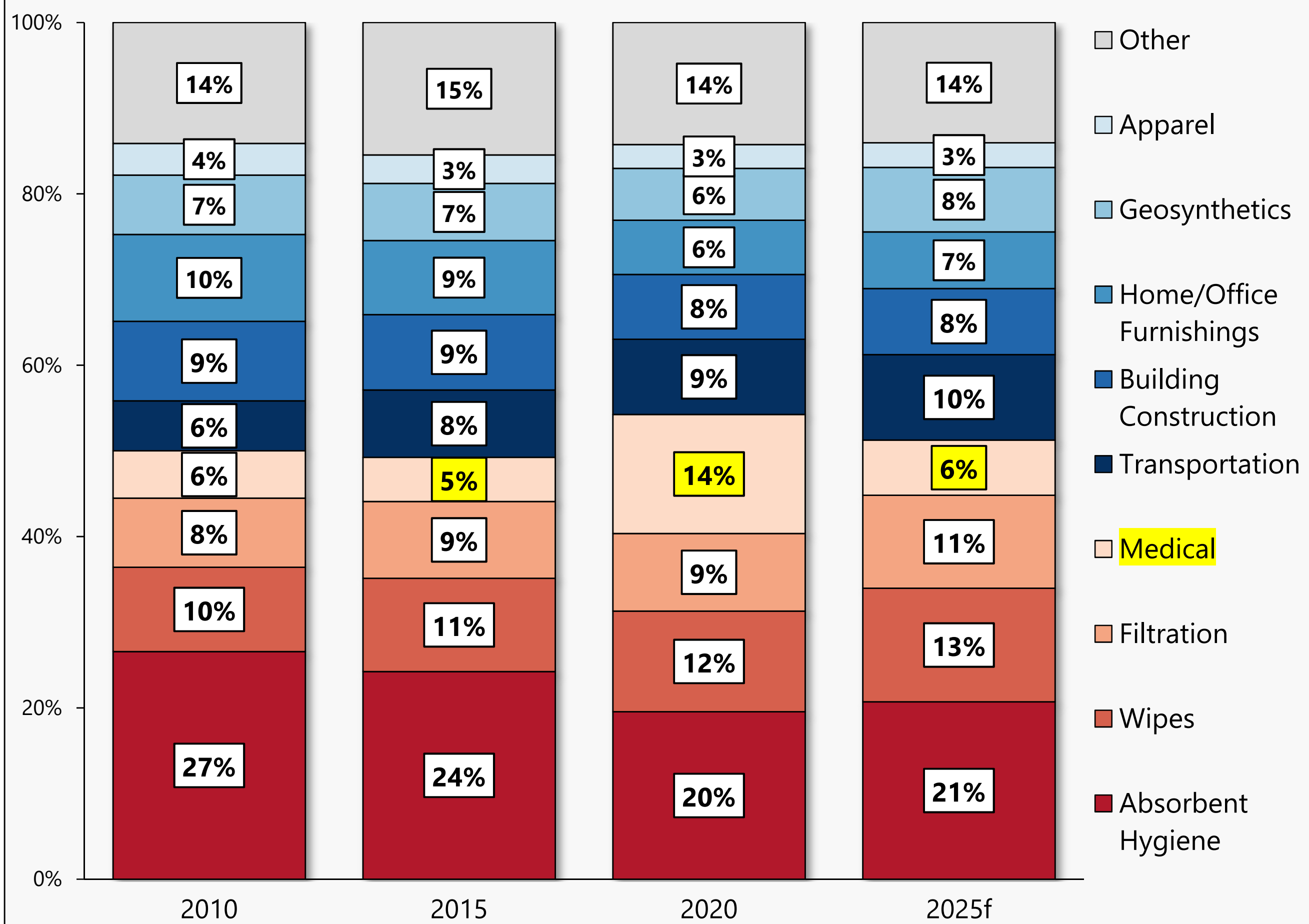
Through the forecast period the medical end use returns closer to its historical share as some of the demand for protective medical apparel abates, but also as the vehicle and housing construction markets ramp back up (Figure III-2, Table III-1, Figure III-3 and Figure III-4A).

At the end 2025, the absorbent hygiene end use is still forecast to be the largest market, accounting for 21% of the global production. Meanwhile, as the need to keep the surfaces we touch clean, protect the air we breathe and the liquids we drink clean, the production shares of wipes and filtration continue to rise (Figure III-2, Table III-1, Figure III-3, Figure III-4A and Figure III-4B).

Figure III-2

Global Nonwovens Production Share by End Use

(Tonnes)



Source: INDA/EDANA/ANFA estimates, 2021

The spectrum of nonwovens end uses is very broad, and each market segment has its own drivers, each discussed later in the section. The split between short-life/disposables and long-life/durables is far from being sufficient to analyze the evolution of the nonwovens market. Though many of the short-life end uses, specifically absorbent hygiene and wipes, are influenced by dynamics with the population and rising disposable income, single-use end uses are not at the same stage of their market developments or penetration rates at a global level, especially the use of nonwoven medical fabrics.

Growth drivers in the advanced and developed markets tend to rely more on fundamentals such as income (discretionary spending) and population drivers; while emerging and developing markets also rely on income (GDP per capita) and habit formation, that is, an increasing penetration rate of product usage, such as wipes. Certain consumer products in advanced countries, however, are subject to changes in terms of consumer behavior and perception, based on the perceived sustainability of materials and products. This trend may negatively influence the demand of single-use products, especially with the arrival of millennials as young parents and the availability of new cloth diaper alternatives. However, the industry is addressing this challenge through material science, through developments in biopolymers, usage of natural fibers, composability, recyclability, and the implantation of advanced recycling technologies.

Within the durables end uses—as seen in some regions with a slowing economy—end use can vary greatly, as the building construction and transportation markets did not react in the same way during the historical period. This is a result, in general, of some of the durable end uses—notably transportation—taking share from other materials, due to the flexibility of an engineered fabric that through innovation can be adapted to meet the needs of materials for today and into the future. Nonwovens provide options for weight and cost savings due to their versatility, functionality and recyclability.

Table III-1

Global Outlook for Nonwovens Production by End Use

(Thousand Tonnes)

End Use	2010	2020	2025f	Growth (AAGR) 2010-2020	Growth (AAGR) 2021-2025
Absorbent Hygiene	2,603	3,491	4,232	3.0%	3.9%
Wipes	966	2,100	2,712	8.1%	5.3%
Filtration	790	1,620	2,217	7.4%	6.5%
Medical	542	2,480	1,317	16.4%	-11.9%
Geosynthetics	678	1,080	1,541	4.8%	7.4%
Home/Office Furnishings	994	1,131	1,349	1.3%	3.6%
Building Construction	910	1,351	1,578	4.0%	3.2%
Transportation	571	1,570	2,038	10.6%	5.4%
Apparel	363	498	588	3.2%	3.4%
Other	1,382	2,543	2,869	6.3%	2.4%
Total	**9,799**	**17,863**	**20,440**	**6.2%**	**2.7%**

Source: INDA/EDANA/ANFA, 2021

In the previous ten years (2010–2020), average annual growth rates (AAGR) across the end uses ranged from 16.4% (medical) to 1.3% (home and office furnishings). Through the forecast period (2021–2025) geosynthetic applications are expected to experience the strongest growth (7.4% annually), while the slowest is forecast to be the medical category (–11.9%). Through the forecast period, overall nonwovens production is forecast to expand 2.7% annual (Table III-1, Figure III-3, Figure III-4A, and Figure III-4B).

The last issue of this publication, formerly the Worldwide Outlook for the Nonwovens Industry projected 4.8% annual growth through the forecast period (2018–2023), slower than the growth (7.1%) through the last five years (2015–2020), given the increase in 2020 production. This forecast was still a little conservative, given the growth in the 2015–2019 period was 5.8%.

In this year's report there are some important caveats about the data, specifically: the usage and understanding of average annual growth rates, the COVID-19 induced data anomaly of 2020, and category classifications. Having an understanding of these issues will give the reader a better understanding of the data and utilizing the appropriate metrics.

Annual Growth Rate Comparison Caveat

First, the comparison of average annual growth rates (AAGR). As a market grows, the denominator, continues to increase, thus a five-percent growth rate of a million-tonne market is not the same, in terms of material growth, as five-percent growth in a thousand tonne market. In this example, a one-year five-percent growth in a million-tonne market is an additional 50,000 tonnes; while five-percent growth in the thousand tonne market is 50 tonnes. There is a tendency to compare AAGR equally across markets in determining attractiveness. As an example a 25% growth looks more attractive than a 5% growth rate. But given our example above, 5% annual growth rate through 5-years in the million-tonne market would result in an additional 276,282 tonnes and 25% annual growth through 5-years in the thousand tonne market would be an additional 2,052 tonnes. Whether 25% is better than 5%, may depend upon your objectives. There are numerous metrics that can be used in understand the markets; this report also includes absolute tonnage growth, such as in Figure III-5.

Impact of COVID-19 on the Growth Rates

A second issue in comparing the annual growth rates, is that the impact of COVID-19 occurred at the end of the historical period and the beginning of the forecast period. Depending upon the end-use market COVID-19 had a significant impact. Typically, nonwoven manufacturers can produce material for multiple end uses. When the pandemic caused a considerable demand for medical apparel, wipes, and face mask material, producers were able to decrease production in one end use and increase production in those. As a result, some of the historical growth rates, notably medical and wipes, are higher than they would have been without the pandemic. Likewise, some of the forecast growth rates are lower and do not represent the underlying demand characteristics, given the large base some of the end-uses were starting from at the end of 2020. The medical end use is the obvious example—as you'll notice in Figures III-2, III-3, and III-4A—with a historical annual growth rate of 16.4% and forecast growth rate of –11.9%. Does this mean demand is declining through the forecast period. Yes, from 2020 to 2021, and no, from 2022 through 2025.

End-Use Category Classifications

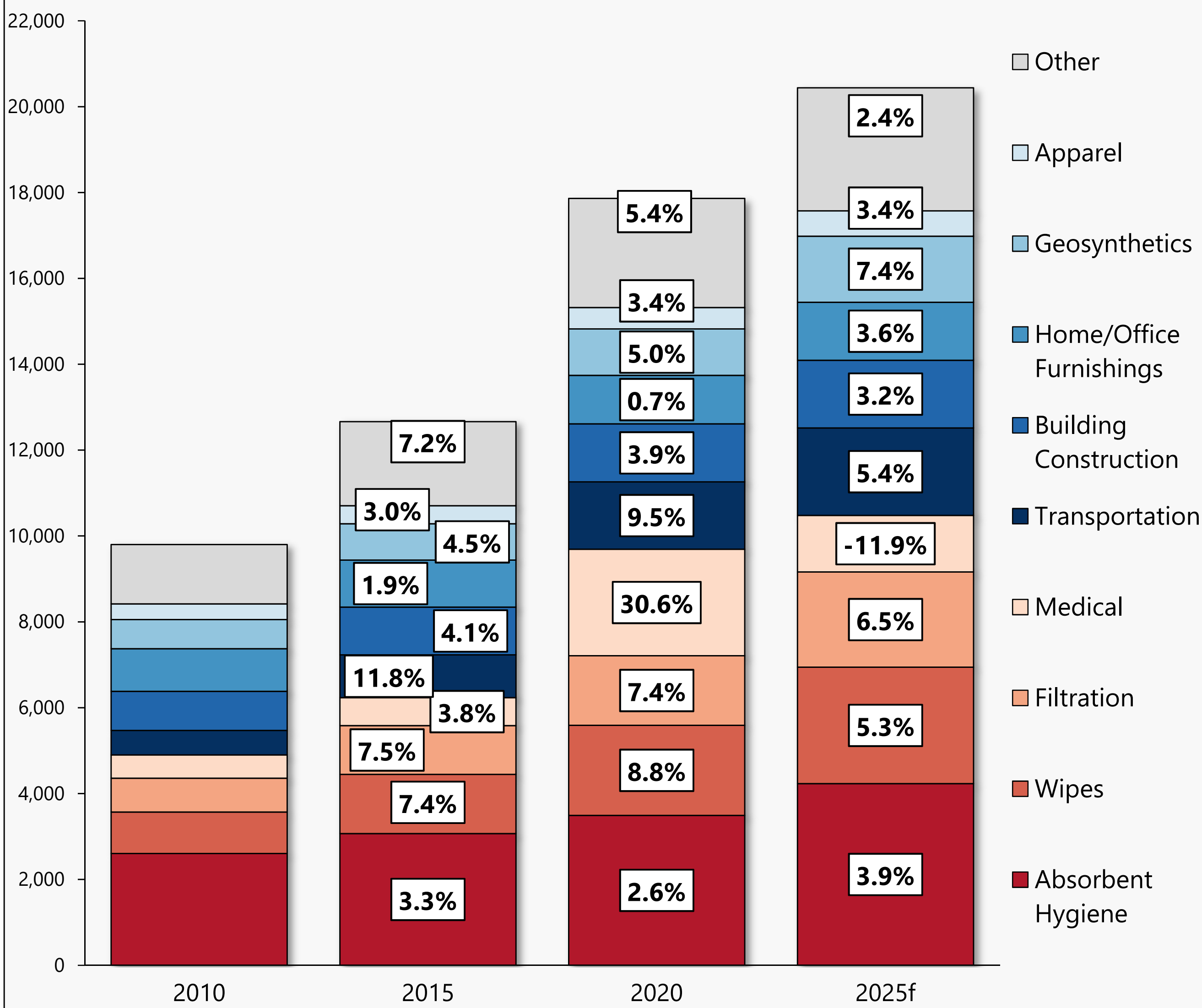
Given the significant growth in the medical end-use it is best to have an understanding what is included in that end-use. INDA includes medical apparel, sterile packaging/sterilization wrap and wound care (surgical gauze including pads, sponges, undercast padding, and wound packing; surgical tapes; wound dressings, primarily non-adherent dressings). EDANA includes face masks, assumed to be medical face masks, in the medical category. It is also thought the Asian associations have also included face masks in the medical category. While much of the material produced in response to the pandemic was for medical markets, that is typically not the case for the respirator market. Personal protection face masks include those sold at the consumer level and those used in industrial, commercial, and healthcare environments. Additionally, respirators range from full hood to full- and half-face pieces to disposable half masks covering just the mouth and nose. Some respirator masks come with replaceable-nonwoven cartridges. The respirator market includes both medical respirators and industrial respirators. The industrial respirator market is larger than the medical market. 3M, one of the world's largest respirator producers, stated that prior to the pandemic 90% of its respirators went to industrial uses, but that ratio, obviously, flipped during the pandemic as the masks have proven key to protect essential workers.

Figure III-3

Global Nonwovens Production by End Use

(Thousand Tonnes)

Annual Percent Change (AAGR) from Preceding Five-Year Period



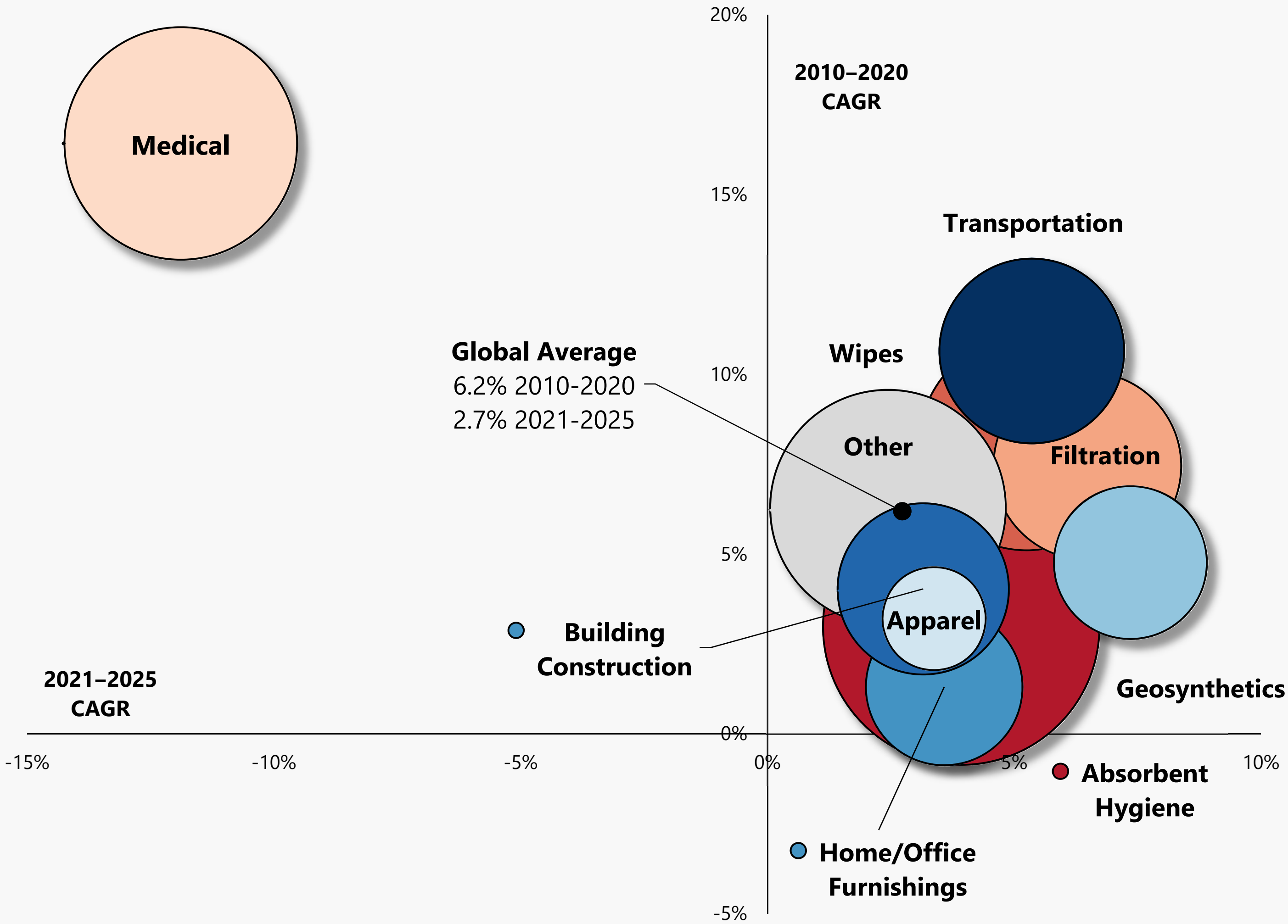
Source: INDA/EDANA/ANFA estimates, 2021

Figure III-4A provides a graphical representation of Table III-1 and summarizes the historical growth (2010 to 2020 average annual growth rate, AAGR) along the y-axis and the forecast growth (2021 to 2025 AAGR) along the x-axis, by the size of each end- use production (in tonnes, 2020) represented by the size of the circle. The black dot in the middle—indicating the global average—allows for relative comparison of the individual end uses to the global average.

Figure III-4A

Nonwovens Production by End Use
Market Sizes and Growth

Historical CAGR (y-axis), Forecast CAGR (x- axis) and Bubble Size in Tonnes of Production, 2020



Source: INDA/EDANA Estimates, 2021

This figure (Figure III-4A) displays the extreme outlier nature of the medical category, which in this figure is the fastest growing through the historical period, and given the significant drop-off of medical apparel production in 2021, is negative through the forecast period.

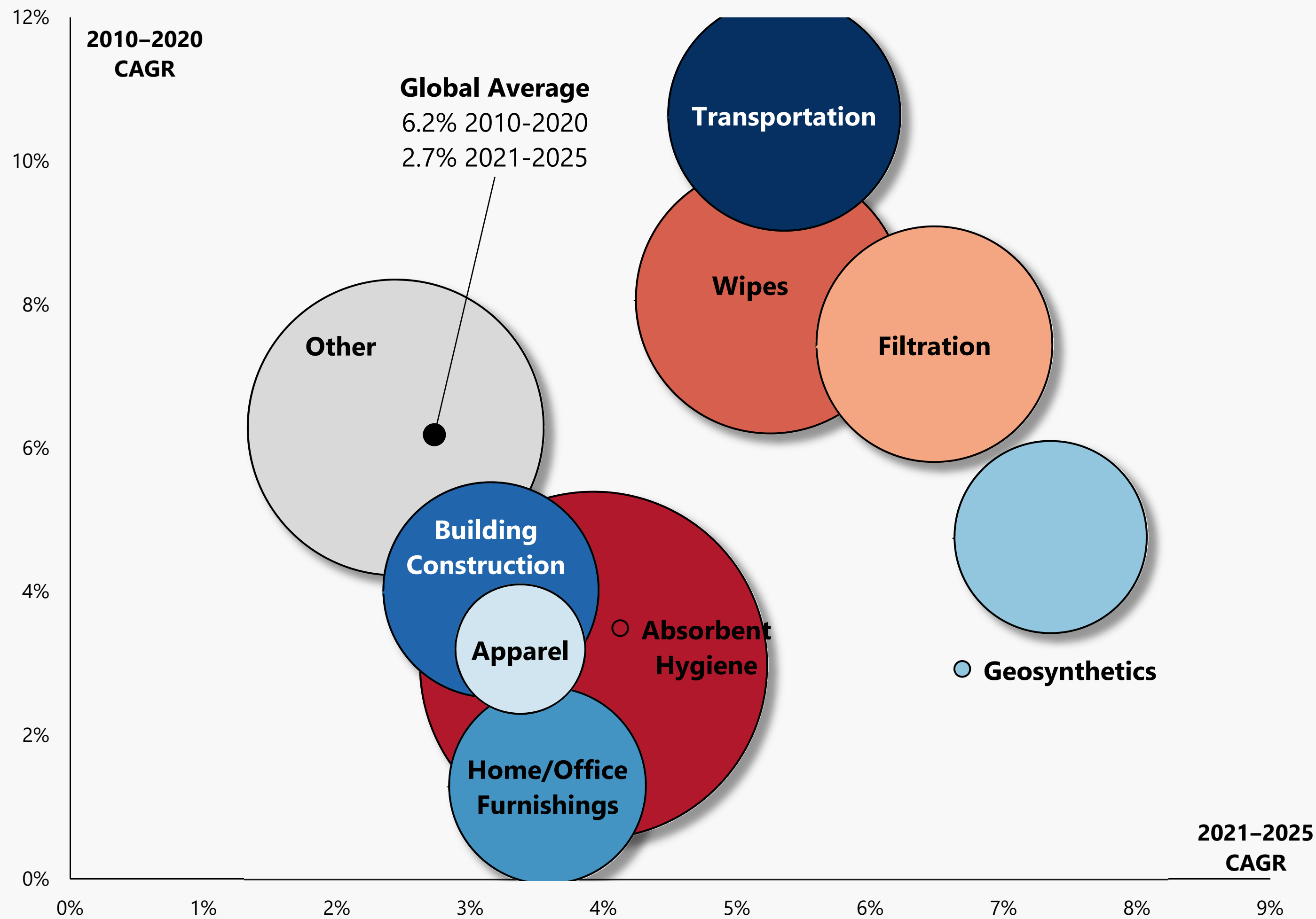
Because of the outlying circumstance of the medical category, it makes it difficult to observe the differences within the other end-use categories. Therefore, a separate bubble-chart figure is provided (Figure III-4B).

Excluding the medical category, one can view that growth of the segments tends to fall into two categories: those with higher historical and forecast growth rates (transportation, wipes, filtration, and geosynthetics) and those with slower growth rates (home/office furnishings, absorbent hygiene, apparel, building construction, and other) (Figure III-4B).

Figure III-4B

Nonwovens Production by End Use, Less Medical
Market Sizes and Growth

Historical CAGR (y-axis), Forecast CAGR (x- axis) and Bubble Size in Tonnes of Production, 2020



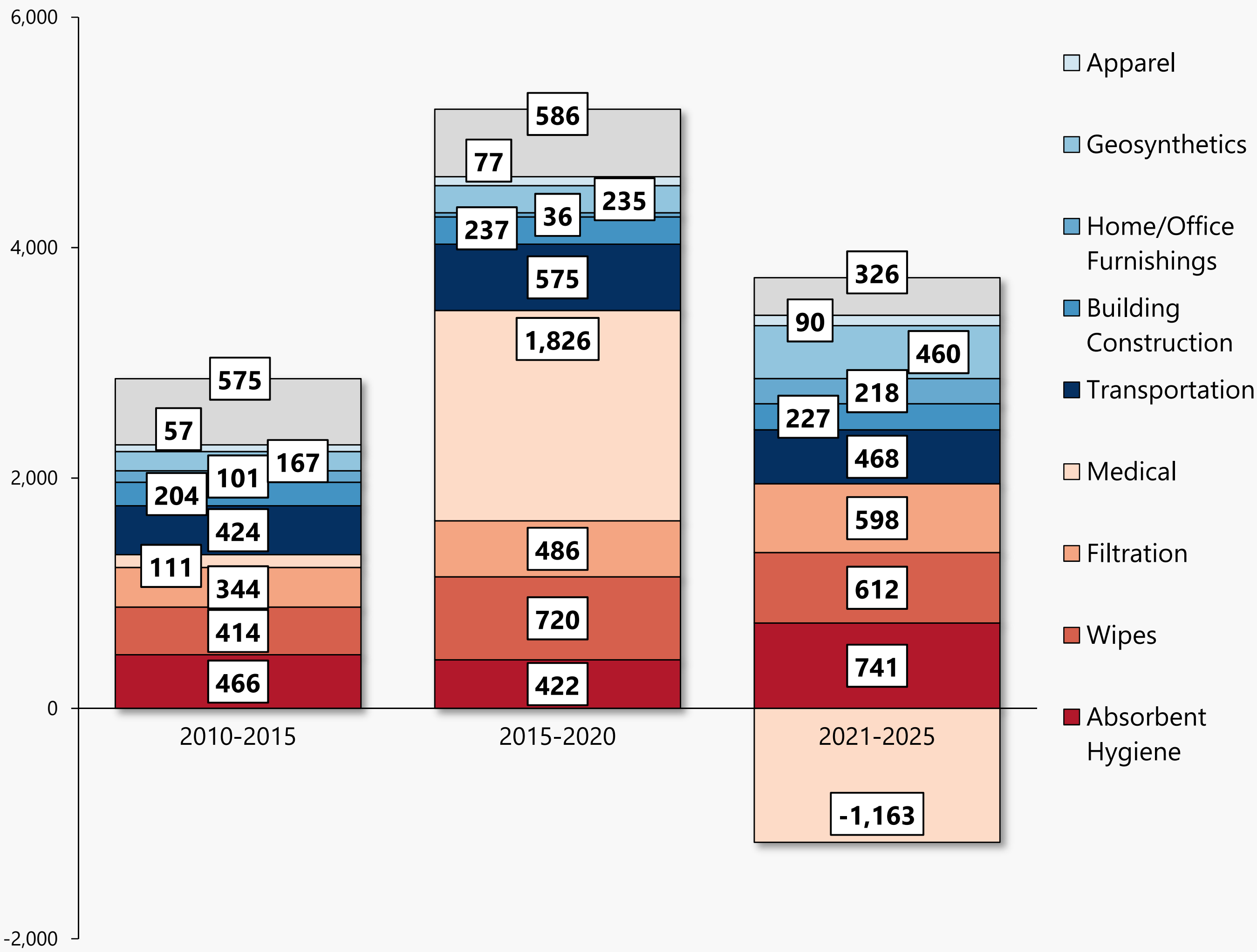
Source: INDA/EDANA Estimates, 2021

Typically, as absorbent hygiene and other category are the largest markets, they tend to add the most incremental tonnage, as they did in the 2010 through 2015 period, with both combined adding over a million tonnes of incremental growth (absorbent hygiene 466,000 tonnes and other adding 575,000 tonnes). However, this is not the case in the recent period (2015–2020), as medical production added an additional 1.826 million tonnes in that period, with the majority of it being produced in 2020 and in China. The wipes segment also added an incremental 720,000 tonnes in that period, with much of also being produced in 2020 (Figure III-5).

Figure III-5

Global Nonwovens Production Incremental Tonnage by End Use

(Thousand Tonnes)



Source: INDA/EDANA/ANFA estimates, 2021

However, that is not expected to be the same through the forecast period; while absorbent will go back to adding the most incremental tonnes, 741,000 tonnes, the wipes and filtration categories will follow closely behind, adding an additional 612,000 and 598,000 tonnes, respectively. The wipes and filtration categories are expected to be positively impacted with a net increase in demand, and therefore production, as a result of the pandemic; however, as discussed, medical apparel production is forecast to precipitously decline in 2021, resulting in a decline of 1.163 million tonnes through the forecast period (Figure III-5).

The remainder of this section provides an analysis of the production by region of nonwovens in each of the main end uses. Obviously, various types of nonwovens can meet the same requirements for a particular end use. Hereafter, though, all types of nonwoven materials are considered without any differentiation by web-forming or bonding process and the different ways to substitute nonwovens with other nonwovens to fulfill the same product requirements in a particular end use won't be explained. Moreover, the presentation of data in tonnage does not allow for the measure of the products' weight reductions during the historical nor the forecast period. This decline in grammage has been particularly significant in the absorbent hygiene market, for instance.

Absorbent Hygiene

The absorbent hygiene category includes **baby diapers and training pants (nappies)**, **incontinence products**, and **feminine care products**. Additionally, though quite small, the absorbent hygiene segment includes a pet end-use category that includes pet diapers, primarily for lap dogs and cats, and pet underpads, primarily used for housetraining puppies. The absorbent hygiene end-use category is the largest (in tonnage) of the nonwoven end-use segments, consuming a fifth (20%) of the world's nonwoven material in 2020, and is projected to slightly increase its share through the forecast period (21% in 2025) (Figure III-2).

The absorbent hygiene market is composed of two channels: consumer (those products purchased by individuals, typically in a retail setting), and institutional (products purchased by companies or people responsible for the care of others). The majority of institutional absorbent hygiene products—briefs, underwear and underpads—are sold to hospitals, nursing homes, residential care facilities, and other institutions. They are typically purchased in bulk from just a few cases to larger volume quantities.

The absorbent hygiene market is **primarily driven by demographics**—that is, babies (for baby diapers), women experiencing menstruation (for feminine care products), and the elderly (for incontinence products—though incontinence products are used by others as well, not just the elderly).

The **main drivers** of absorbent hygiene product demand include

- number of births;
- an aging population with increased life expectancy; and
- increasing disposable income in the emerging and developing markets.

Secondary drivers include

- convenience;
- product innovation (absorbency, comfort, discretion, fit, odor, skin health);
- increasing consumer awareness and acceptance of incontinence products;
- increasing hygiene concerns in the emerging and developing markets; and
- desire for eco-friendly products: natural ingredients, free from preservatives, sustainable materials, recyclable, biodegradable in the mature markets; and
- offering a product range from premium to—as a result of the economic fallout from the pandemic—products focused on affordability.

Product innovation has been and will continue to be a driver in absorbent hygiene products, specifically the quest for discrete products: thinner, quiet, odorless. Consumers see value in thinner products, be they better-fitting diapers or less-conspicuous feminine care and incontinence products. Additionally, with thinner products there is the ability to get more product on the shelf, combined with savings in both packaging and shipping. More than 40% of the nonwoven-related patents issued over the past year were within the absorbent hygiene area. This product innovation is being undertaken not only by the branded consumer packaged goods (CPG) companies, but by the private-label manufacturers as well. These product innovations continue to allow nonwoven suppliers the opportunity to provide specific functional performance and aesthetic properties that are required for the many types of nonwoven components in absorbent hygiene products. These product innovations and the use of natural materials/ingredients also allow brands to continue to roll out premium products. However, it is important to understand consumer priorities in the features they are willing to spend on to tailor innovation, especially for some households in the economic-strained post-pandemic environment or in lower-income countries.

In 2020, tonnage consumed by the nonwoven absorbent hygiene end use reached nearly three-and-a-half million tonnes (3.491), an annual increase of 3.0% from 2010. By 2025 the end use will consume an additional 741,000 tonnes (148,200 tonnes annually), reaching over four million tonnes (4.232), a 3.9% annual growth rate (Table III-2, Figure III-6 and Figure III-7).

Table III-2

Absorbent Hygiene Nonwovens Production by Region

(Thousand Tonnes)

				Growth (AAGR)	
Region	**2010**	**2020**	**2025f**	**2010-2020**	**2021-2025**
North America	898	657	730	-3.1%	2.1%
Greater Europe	573	858	927	4.1%	1.6%
Asia	855	1,559	1,977	6.2%	4.9%
South America	168	186	232	1.1%	4.5%
MENA	87	195	301	8.4%	9.0%
Rest of World	22	35	65	4.8%	13.2%
Total	**2,603**	**3,491**	**4,232**	**3.0%**	**3.9%**

Source: INDA/EDANA/ANFA, 2021

Our forecast in the last issue of the Worldwide Outlook for the Nonwovens Industry was on the optimistic side, forecasting 4.3% annual growth from 2018 through 2023. The forecast was overly optimistic in the Americas, not accounting for the continued decline in birth rates, economic downturns, and the continued light-weighting of absorbent hygiene nonwoven material. However, the forecast is comparable to the pre-pandemic period, with an annual growth of 4.5% from 2015 through 2019.

Baby Diapers

The baby diaper/nappy category not only includes baby diapers but also pull-up training pants and swim pants. Baby diapers today are complex structures made with numerous nonwoven components performing various functions. Coverstock is a generic term that refers to certain nonwoven components used in absorbent hygiene products, including the top sheet and back sheet. Other nonwoven components include barrier leg cuffs, waist band, typically an absorbent core and core wrap, acquisition and distribution layers, and some fastening systems.

Producers of baby diapers are constantly improving the numerous components, sometimes adding components or reducing them. Many of these changes have resulted in a reduction in the overall basis weight of the components within the diaper. The baby diaper is a constantly evolving and changing structure. Based on INDA's analysis, it takes slightly less than a half square meter of nonwoven material to make an average baby diaper and around a half square meter to make an average training pant. This is 11% less material for both baby diapers and training pants than in 2010. Along with the use of less material, the number of grams per square meter (gsm) also continues to decline. According to EDANA, the average weight of hygiene nonwovens was around 19.5 gsm in 2010 and is now down to 18.2 gsm in 2020; however the average in 2019 was 17.8 gsm. This constant evolution of material size and weight will continue to dampen tonnage growth through the forecast period. This may be offset by nonwoven producers' ability to provide specific functional performance and aesthetic properties with continuing product innovation around performance in absorbency and leak protection (optimizing the core system), skin health (in regard to dryness, breathability, skin contact, and wetness indicators), softness, and thinness for a better fit.

The key factors driving the growth of the diaper market—in addition to the absolute number of babies—include rising disposable income, increasing urbanization, decreasing mortality rate among infants, rising popularity of diaper pants, and improved living and hygiene standards.

The use of diapers in most countries is significantly influenced by cultural standards, family practices and income levels. Another trend in some of the developed countries is that the age for toilet training has increased dramatically. The convenience of disposable diapers, pull-up diapers, and more efficient laundry facilities may have contributed to this trend. The development of nighttime diapers, training "pull-up" pants, and swim diapers has increased the age at which "diapers" are still worn by children. Not only have pull-up training pants taking share lengthened the time that children spend in diapers, they have also taken share from diaper-wearing babies. This has impacted the nonwovens usage and future potential usage for this segment.

While the penetration rate of babies wearing disposable baby diapers is above 90% in the majority of the developed markets, one-third of the world remains below five percent penetration rate.

Incontinence Products

In the past, people generally thought of incontinence as a problem limited solely to elderly people in institutions. EDANA and INDA used to refer to this category as Adult Incontinence, with absorbent underpads in a separate category. Not too long ago, incontinent sufferers had very little to choose from in terms of products. In fact, the adult diaper—which was nothing more than a larger version of a baby diaper—was the only product in the former Adult Incontinence category. Those who experienced light incontinence, especially those under the age of 65, had no incontinence products to choose from and had to make do with feminine hygiene products that were best suited for other purposes.

The subject of adult incontinence has long been associated with the elderly. However, the National Association for Continence (NAFC) says incontinence, or loss of bladder or bowel control, is a symptom, not a disease in itself, and that a broad range of conditions and disorders can cause incontinence, including birth defects, pelvic surgery, injuries to the pelvic region or to the spinal cord, neurological diseases, multiple sclerosis, infection, and degenerative changes associated with aging. The U.S. Centers for Disease Control and Prevention (CDC) National Center for Health Statistics (NCHS) published a report on Prevalence of Incontinence Among Older Americans in June 2014. Of non-institutionalized persons age 65 and over, 51% (61% of women and 38% of men) reported a urinary leakage and/or accidental bowel leakage (ABL) of mucus, liquid stool, or solid stool. More than half (55%) of the noninstitutionalized women and more than one-quarter (30%) of noninstitutionalized men age 65 and over reported urinary leakage. Restricting the definition of bladder incontinence to include only moderate, severe, and very severe levels of incontinence reduced the percentage of non-institutionalized men and women with bladder incontinence from 44% to 24%. When only severe and very severe levels were considered, the percentage with bladder incontinence was 8%. These numbers at the consumer level clearly identify a need for products for specific functional performance levels. Additionally, approximately 2 to 3% of adults continue bedwetting since birth.

However, incontinence impacts more than just the elderly. While it is true that incontinence is more prevalent among older people, incontinence can strike anyone. In the United States, 4 out of 10 (40%) women ages 18 through 64 experience some level of stress urinary incontinence, while 7% have an incidence of non-stress urinary incontinence. Men are less likely to experience stress urinary incontinence (2.6%) or non-stress urinary incontinence (2.3%).

This data lead to some significant population numbers of those impacted to some degree by incontinence. Although the percentage of adults with incontinence has remained the same, as the population ages, there will be more people with the problem.

Today **numerous products are available to fit the consumer's needs**. Now the market offers more than just an "adult diaper"—from liners, pads, and shields to briefs (standard diaper design) and underwear (premium pull-up design), as well as absorbent underpads, which have been added to the renamed incontinence products category.

Bulky, uncomfortable adult diapers are relics of the past. Manufacturers have recognized that today's incontinence sufferer is more than just the elderly woman at a nursing home, but are also younger people who still have very active lifestyles who seek products that will allow them to lead normal lives while managing their individual conditions.

Today's incontinence products are far more streamlined and hug the body to give discreet and comfortable protection. Manufacturers have produced and marketed products in different sizes and shapes with functional performance levels to meet the specific needs of consumers of different genders and ages and with different levels of incontinence. In the past, women used feminine care products for their light incontinent needs. Today, the major brands would like to convert those women to a product more suitable for their needs—a specific incontinence product, which on average tends to be more expensive than feminine care products. So, while the incontinence category may grow, it may also cannibalize feminine care product sales.

Just like in other absorbent hygiene categories, natural products are beginning to emerge in the incontinence space.

In addition to significant improvement in the product, the combination of an aging population—including the high prevalence of urinary incontinence—and the continued efforts by manufacturers to diminish the social taboos and misconceptions surrounding incontinence products will create an environment for strong sales.

Institutional care and homecare used to account for more than half of the global market for incontinence products. However, in the latter half of the 2000s and early 2010s, incontinence products growth in institutions and the homecare sector was low, negatively impacted by cost-cutting programs in many countries, which resulted in changes in reimbursement systems. On the other hand, the retail market for incontinence products showed continued strong growth in both the developed and emerging markets.

While indeed a significant percentage of the non-institutionalized population is impacted by incontinence issues, historically only a small percentage has purchased incontinence products. The product usage or penetration rate was low due to both the appropriate product not being available and the social stigma of purchasing such products in a retail environment, especially for those not considered elderly.

Euromonitor's International Health & Nutrition Survey 2020, found approximately 30 percent of women use feminine care products for incontinence issues. This varies by age with 40 percent of women ages 30 to 44 using feminine care products for incontinence management, 45 percent of women ages 45 to 59, and 11 percent of women 60 and older.

This wide range of incontinence sufferers has opened up opportunities for manufacturers to innovate in this space, and they are continuing to improve absorbency levels, odor control, skin friendliness and breathability in new products. These new developments in pads, disposable underwear, adult diapers and other products have allowed manufacturers to grow and reach new customers. Factors such as increasing awareness and understanding of various incontinence conditions, normalization and better access to products are contributing to this growth.

Many manufacturers see the incontinence market as a major growth engine in which both online sales platforms and product innovation represent important means of overcoming consumer reluctance to embrace the products. Manufacturers are focusing on catering to individual customer segments by gender, age group, and activity level to best meet the needs of their target population, developing a range of products to provide absorbent capacity—from little leaks to overnight protection. For example, a couple of years back a new product was introduced to a previously unserved market; those with accidental bowel leakage (ABL). It is estimated that 20% of women age 40 and over experience ABL. The new liner product category fills a previously unmet need: body liners that put secure protection where the problem is, typically with an absorbent core and odor protection to protect against accidental leakage.

Performance requirements of incontinence products are significantly different when comparing institutional and consumer products. Consumers, specifically aging Baby Boomers, want to continue with their social life and actively participate in activities without restrictions and, more importantly, without fear. This puts emphasis on the need for discreetness, comfort, and leakage protection during active use, as well as the need for the product to look and behave like a piece of clothing. This requires the consumer product to be:

- Discreet – A product that is thinner, quiet, odor free, and not visible.
- Comfortable – A product that is softer, breathable, and allows normal movement while maintaining fit with the ability to stretch and recover.
- Safe – A product that does not leak and maintains integrity even under pressure while maintaining skin health by moving the liquid away from the skin (all related to the previously mentioned core design and optimizing the core system).

Product innovation will continue to boost product adoption and, consequently, market penetration as the market population is growing. Additional forms of retailing—online and auto-replenishment, for example—will also assist in market penetration. New products are reaching the adult incontinence market rapidly to meet specific needs, such as those for accidental bowel leakage (ABL), light incontinence (liners and pads), and products designed specifically for men (shields). Offerings that are more stylish and appear less medical have helped normalize the category.

Branded manufacturers—leading the innovation and marketing—seem to be holding their own quite nicely against competition from the private-label makers by extending product applicability through brand extensions targeting specific needs for absorbent products.

Feminine Care

Feminine care is a collective term used for the description of personal care hygiene products used by women during menstruation, for menstrual discharge, and other bodily functions related to the vulva. The sanitary protection industry can be broadly classified into three main categories—sanitary napkins, panty liners and tampons. Feminine care products are highly absorbent products, designed for absorption or collection of menstrual fluid.

The feminine care segment, though large in units sold, is the smallest of the absorbent hygiene categories. In the segment, panty liners and sanitary napkins consume the majority of nonwoven material, consuming nearly all the tonnage. This is because most tampons (~90%) use a limited amount of nonwoven material in their construction. The tampon's absorbent material is generally made from bleached cotton, rayon, or cotton/rayon blends with a small section of nonwoven included to add strength, and sometimes a nonwoven is used to wrap the product.

Sanitary protection is an indispensable necessity product extensively used throughout the world in the developed markets by women in the ages of 13 to 51 years. In the these markets, demand for feminine care products largely tracks population growth. However, growth will exceed population growth in emerging and developing markets with increasing disposable income, health consciousness and awareness, leading in an increased adoption of feminine care products in those regions.

The growth of the feminine care market is driven by urbanization, increasing population of working women, growing awareness about female hygiene, rise in the global menstruating population and investments by the global hygiene companies in emerging and developing countries. However, growth of sanitary protection still remains under-penetrated in a major part of developing and undeveloped nations around the world. Manufacturers are expected to focus on untapped rural markets and increase their corporate social responsibility activities related to women's hygiene. Furthermore, some governments are encouraging companies to conduct hygiene campaigns, devise support, and use marketing strategies to change the perceptions of women and build their self-confidence and self-esteem, and to help school-age girls and teenagers keep attending school during menstruation, thus accelerating the global feminine care market across the world. A potential market restraint is the growing number of options in substitute products.

Of the absorbent hygiene product consumers, feminine care product consumers tend to be the most brand loyal, though private label has been gaining share in the segment over the years. Perhaps in response—and another form of innovation—a premium category has been created in the feminine care market. These products—through marketing and packaging — tend to target young consumers by marketing them as a lifestyle accessory as opposed to a commodity.

While going after the younger "tween" consumer has always been a major focus of feminine hygiene producers, brands have recently developed strategies aimed at attracting the attention of women of all ages—not just from their first period, but also through pregnancy (or the prevention of it) to stages later in life. Today, these brands are offering products for more than just period care.

As with incontinence products, manufacturers offer a range of products for specific needs—thin, active, heavy-flow or overnight use.

Innovation will focus on the thickness and functionality of the products, in addition to women's skin health and convenience. Conversely, there is also a trend of using less material and lighter material—similar to baby diapers—that may offset some of the other gains.

Feminine care products appear to be shifting towards more healthy product positions with stronger messaging, especially when it comes to tampons. Some of the mainstream brands exploring this healthier trend are making claims that their products are free of particular ingredients.

The continued roll out of natural-based and organic-based feminine care products, coupled with legislative efforts to regulate packaging and ingredient listings in the market, is revolutionizing this category and helping women have healthier lifestyles.

The rate of introduction of new, natural-based feminine hygiene products is redefining the category as brands both large and small respond to the female's need for alternative ingredients.

Region View

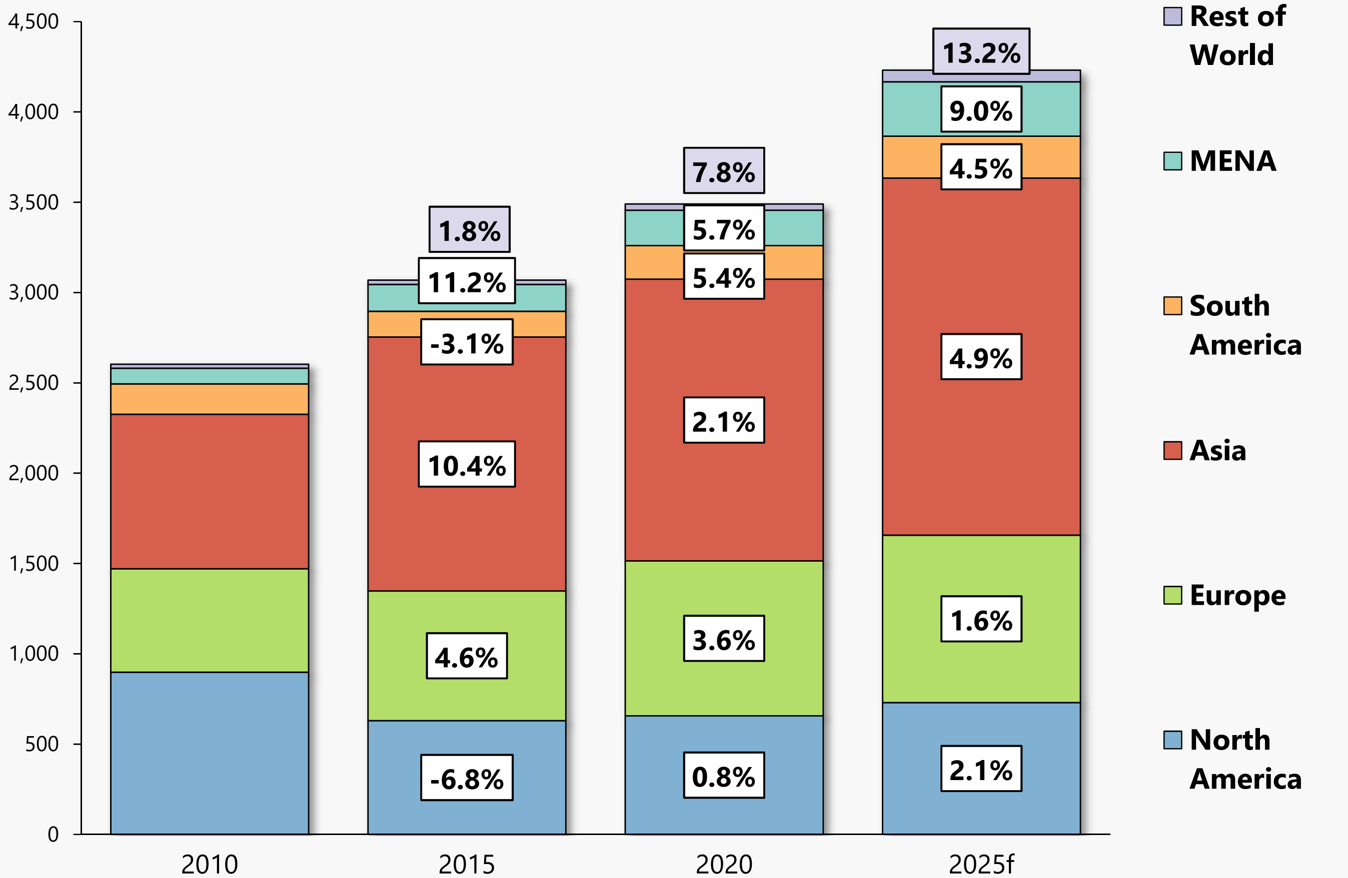
Generally, throughout the emerging and developing markets, increasing disposable income leads to rising expenditures or consumer spending, and increasing hygiene concerns are expected to fuel demand for absorbent hygiene products through the forecast period. Further, the demand for feminine care products in the emerging and developing markets is being fueled by changing lifestyles, growth in the number of working women, the rising consciousness of feminine hygiene, and growing preferences for convenient products.

Figure III-6

Absorbent Hygiene Nonwovens Production by Region

(Thousand Tonnes)

Annual Percent Change (AAGR) from Preceding Five-Year Period



Source: INDA/EDANA/ANFA estimates, 2021

Asia led the regions in ten-year annual historical growth (6.2%) in incremental tonnes produced, producing an additional 704,000 tonnes of nonwovens for absorbent hygiene, while the Middle East and North Africa (MENA) region led in overall growth rate (8.4%). Going forward (2021–2025), the fastest growing regions are forecast to be the Rest of the World region—which includes the large populations of Nigeria, Ethiopia, and the

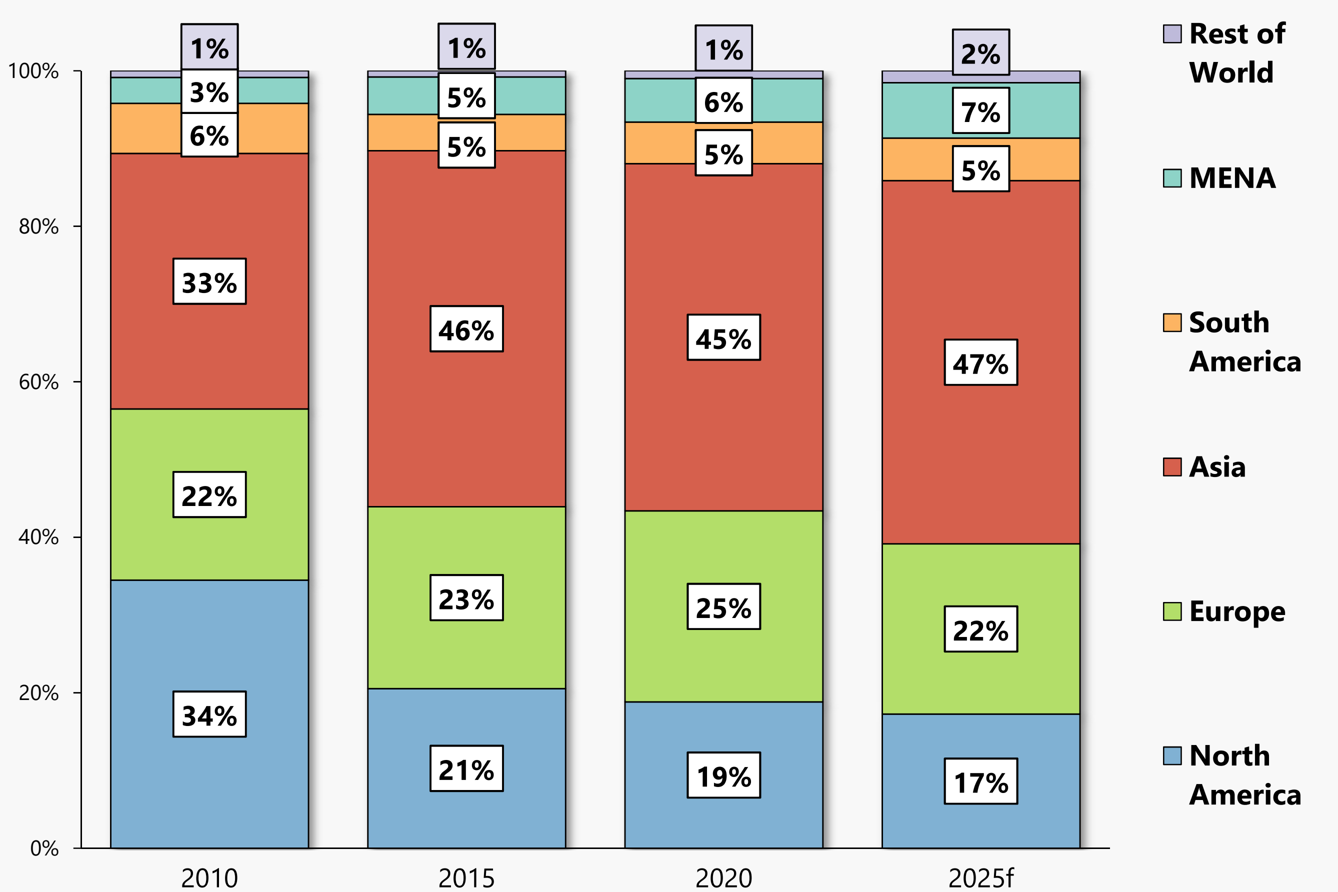
Democratic Republic of Congo—expanding 13.2% annually and the MENA region at 9.0% annually. However, these regions are both starting from relatively small bases and, combined, will add an incremental 135,800 tonnes, near that of both North America or Greater Europe combined (142,000 tonnes), but significantly below the estimated 417,500 tonnes the Asia region will add through the forecast period (Table III-2 and Figure III-6).

Asia's global share of the absorbent hygiene nonwoven global production—driven by China—is forecast to produce nearly half (47%) of the material by 2025. Both North America and Greater Europe lost share from 2010 to 2020, not only to fewer babies being born, but also due to light-weighting (Figure III-7).

Figure III-7

Absorbent Hygiene Nonwovens Production Share by Region

(Tonnes)



Source: INDA/EDANA/ANFA estimates, 2021

North America

North America is the third largest absorbent hygiene nonwoven material producing region, accounting for a 19% of the global market in 2020, having dropped from 34% in 2010 (Figure III-7). The region is forecast to see an increased improvement from its ten-year historical average annual growth rate (–3.1%) to the forecast (2.1%) (Table III-2 and Figure III-6).

This growth will be driven by three dynamics: the beginning of the Echo Boom, an aging population, and the reduction in impact of light-weighting.

As the majority of the Millennials move into their 30s—the peak of the Millennials are currently 25 to 29 years of age—they will start forming families, and will do so at rates not seen since the years following World War II, when the Silent Generation gave birth to the Baby Boomers, thus the term "Boomer Echo." As a result the U.S. Census forecasts an increase in birth rates and in the number of absolute births in the United States and Canada as a result of the Boomer Echo and pent-up demand due to the pandemic-influenced economic downturn. Mexico, on the other hand, is experiencing a decline in birth rates and absolute births as the country continues its economic and social development.

The combination of an aging North American population—specifically the Baby Boomers in the United States—and the continued efforts by manufacturers to diminish the social taboos and misconceptions surrounding incontinence products will create an environment for strong sales. There are 10,000 people turning age 65 every day on average and age is the number one risk factor for incontinence. The longer someone lives, the more likely that some life event or illness will result in symptoms of incontinence. Additionally, growing rates of obesity, cancer, and other health factors further provide a platform for growth in demand as these come usually with increased risks of urinary incontinence.

Demand for feminine care products largely tracks population growth, as the United States and Canada are fully penetrated markets. Mexico, with its smaller population, has experienced an increase in feminine care usage and is forecast to experience more growth.

Greater Europe

Europe is the second largest nonwoven absorbent hygiene material producing region, accounting for a quarter (25%) of the global market in 2020, up slightly from 2010 (22%), driven by production increased outside of Western Europe (Figure III-7).

The Greater Europe region includes many countries that are increasing in population and per capita income, specifically Turkey which accounts for a third (34)% of Greater Europe's population growth between 2021 and 2025, adding 4.96 million people. All of Western Europe will add 5.63 million people through the forecast, though a large portion of that amount is net migration.

Moreover, the growing demand coming from the MENA region has simultaneously required both nonwoven roll goods and converted materials. The development of absorbent hygiene nonwoven production in the Middle Eastern countries has had an impact on Greater Europe's production, by reducing the quantity of hygiene products (nonwoven roll goods or final products) exported from Greater Europe to this region. However, the volumes of nonwovens exported outside of Greater Europe has continued to increase, but at slower rate than historically. Exports of finished products have increased from both Turkey and the Ukraine to the Middle East. This phenomenon partly explains the continuous growth of nonwoven production in Greater Europe despite limited growth in the European consumption of finished products.

Asia

Asia is the growth engine of absorbent hygiene nonwoven production, nearly doubling in size from 2010 to 2020 and will add more tonnage through the forecast period than all the other regions combined. As such, Asia's share of nonwoven production for absorbent hygiene increased from 33% in 2010 to 45% in 2020 (Table III-2 and Figure III-7).

You'll notice in Figure III-7 Asia's share of nonwoven production actually drops (46 to 45%) from 2015 to 2020. This is due to a change of production mix in 2020, with absorbent hygiene production declining 17.2% from 2019 to 2020, as producers switched to producing material for medical apparel, wipes, or face masks. This swing was led by China, whose absorbent hygiene material production declined 24.9% from 2019 to 2020.

As mentioned, the increasing population and disposable incomes will lead to rising expenditures for absorbent hygiene products through the forecast period, as many of these countries are starting from low penetration rates.

China represented 71% of the 2020 absorbent hygiene production in Asia, however, that share was 78% in 2019 and is forecast to rebound to 73% in 2025. Besides the general increase in the Chinese income level, which will have a positive impact on the penetration rates of these products in China as well as anywhere else, two structural factors will impact the absorbent hygiene market in China. First, in 2013 Chinese authorities began easing enforcement of the "one child" policy in certain circumstances. It then raised the limit to two children for all families in 2016, in hopes of encouraging a baby boom. Many in the nonwoven industry expected an increase in the number of births, and therefore additional nonwovens. However, the policy change did not appear to work. As in other countries, there are myriad reasons for the declining birth rate, including rising prosperity and new opportunities for women. China's economic expansion, though, has created a society where many young couples now struggle with economic pressures—including rising education and housing costs—making it difficult to have even one child, let alone two. Secondly, on the positive, China has the largest population of elderly people in the world.

Wipes

The wipes market is classified into two main segments: **consumer** (wipes typically purchased in a retail environment and used by a consumer, typically in a household setting) and **industrial/institutional** (wipes typically purchased by a business or institution and used in an industrial or institutional setting). The wipes category has been the second largest (in tonnage) of the single-use nonwoven end-use segments, but given the significant increase in the medical end use in 2020, wipes slid to the third largest, consuming a 12% of the world's nonwoven material in 2020, and is forecast to slightly increase its share (13%) by 2025 (Table III-1 and Figure III-2).

Globally, the wipes market is **primarily driven by the strength of the economy** (impacting both the consumer wipes and the industrial/institutional wipes markets), the number of **baby births** (impacting baby wipes), and the constant introduction of **new products**.

In the emerging and developing markets, disposable income is once again a key factor, as wipes are not an item of necessity, but one of convenience. It is generally thought that when GDP per capita reaches $7,000, consumers tend to start buying baby wipes, and above $11,000, other wipes products.

In the developed markets, the wipes market continues its strong growth, not only through increased usage and penetration, but through constant product innovation and new applications. Anything that is a liquid or a cream has the potential to be incorporated into a wipe, which provides for plenty of new market opportunities.

A driver in both the consumer and industrial/institutional wipes markets is cleaning for health and coronavirus-related mitigation efforts. Health concerns are an emerging driver of innovation in disposable wipes giving rise to wipes that are better for one's personal well-being, including wipes with milder preservatives for sensitive skin and wipes that help to protect individuals from the many emerging pathogens, such as COVID-19, H1N1, SARS, H7N9, and MRSA.

The **main drivers** of wipes product demand include

- increasing discretionary income and having the ability to purchase wipes;
- an increase in baby births, impacting baby wipes;
- an aging population appreciating the convenience of wipes;

- increasing life expectancy, increasing elderly population in facilities, impacting disinfecting and incontinence wipes,
- cleaning for health and safety for coronavirus-related mitigation efforts in consumer wipes with increasing use of disinfecting wipes;
- cleaning for health and safety for coronavirus-related mitigation efforts in industrial/institutional wipes with increased focus on maintaining clean and safe facilities and work environments;
- urbanization, dense population centers increasing the spread of germs and creating higher concentrations of dirt and contamination, and
- the continued introduction of new products.

Secondary drivers include

- convenience (including flushability);
- productivity for an efficient workplace (simplifying tasks or eliminating other products);
- consistent quality for a task;
- product differentiation (through material or formulation);
- sustainability (including packaging); and
- new markets.

In 2020, tonnage consumed by the nonwoven wipes end use reached 2.100 million tonnes, an annual increase of 8.1% from 2010. By 2025 the end use will consume an additional 612,000 tonnes (122,400 tonnes annually), reaching 2.712 tonnes, a 5.3% annual growth rate (Table III-3, Figure III-3 and Figure III-5).

Wipes production in 2020 was significantly higher in response to the pandemic, while the annual growth rate was 8.8% annually between 2015 and 2020, it was 4.5% annually between 2015 and 2019.

The last issue of the Worldwide Outlook for the Nonwovens Industry forecast nonwoven wipes production to increase 5.3% annually from 2018 through 2023. This is relatively comparable to the actual (4.5%) from 2015 through 2019.

The higher annual growth rates seen in the past are less likely; as for one reason, the bases of many of the wipes categories in the developed markets are becoming quite large, and the market penetration rate in the these markets for some areas of wipes is slowing and may be nearing its cap, such as in some of the individual product-focused wipes in home care.

Table III-3
Wipes Nonwovens Production by Region
(Thousand Tonnes)

Region	2010	2020	2025f	Growth (AAGR) 2010-2020	2021-2025
North America	323	520	609	4.9%	3.2%
Greater Europe	286	570	656	7.1%	2.9%
Asia	263	824	1,209	12.1%	8.0%
South America	23	59	74	9.7%	4.6%
MENA	70	117	153	5.3%	5.6%
Rest of World	0	10	12	n/a	2.8%
Total	**966**	**2,100**	**2,712**	**8.1%**	**5.3%**

Source: INDA/EDANA/ANFA, 2021

Consumer Wipes

The consumer wipes segment is made up of three categories: baby wipes, home care wipes, and personal care wipes. Home care wipes include hard-surface wipes that may include disinfecting and/or cleansing agents and electrostatic products. The home care wipes category also includes automotive cleaning wipes, glass and screen cleaning wipes, furniture polish wipes, metal and stainless steel wipes, and dry cleaning towels and other dry home care wipes. The personal care wipes category includes wipes for varied uses: moist toilet tissue; toddler training; general body cleaning; cosmetic and facial cleaners; hand antibacterial; intimate and feminine care; adult incontinence and bath, facial sheet masques; and other impregnated wipes (such as medicinal and bug repellent).

Wipes are being introduced in completely new markets and product categories that are expected to drive growth. The classic example is Procter & Gamble's (P&G) Swiffer® products, which were introduced more than a decade ago. Swiffer rapidly grew to a billion-dollar brand, starting with dry wipe sweepers and expanding into wet-wipe sweepers, sweeper vacuums, and dusters, and most recently the Swiffer BISSELL® SteamBoost™.

New products are introduced from established consumer packaged goods companies (CPGs) already in the wipes market, but also by companies with adjacent products or formulations that can be applied to wipes, by entrepreneurs looking for the next bestseller, and through brand extensions.

Be it due to limited free time, ease of use, disposability, or portability, convenience continues to drive demand for nonwoven wipes. The convenience of simplifying tasks and eliminating the need for separate product purchases is one of the drivers behind the growing use of application-specific wipes.

Health concerns are an emerging driver of innovation in disposable wipes, giving rise to wipes that are better for the consumer's personal well-being, including wipes with milder preservatives for sensitive skin and wipes that help to protect individuals from the many emerging pathogens, such as COVID-19, H1N1, SARS, H7N9, and MRSA.

Another driver of growth is the significant advancements in the last year—in both machinery and fibers—to meet the growing demand for flushable wipe products while adhering to the guidelines developed by INDA and EDANA (the European Association for the Nonwovens Industry). While drylaid hydroentangling has been used in the past to provide the strength and dispersability needed, both Andritz and Voith/Trützschler have developed a wetlaid hydroentangling technology to provide the ability to hydroentangle smaller fibers.

Another emerging trend is in product differentiation through the material of the wipe or the formulation contained within the wipe. The material can provide product differentiation through either its raw material, such as a sustainable source, or its construction, such as wipes with two different sides providing different attributes, surfaces or microfilaments. The formulation and ingredients can also provide advantages due to the regulatory complexity within some of the wipes categories. There are numerous formulation options, some of which development times can take years, costing up to $500,000. New or non-traditional active ingredients, such as thymol, citric acid, PHMB, and silver, also can provide product differentiation.

A continuing trend in both consumer and industrial/institutional wipes is the concept of sustainability. Sustainability is a concept that has many different meanings depending on the contact and audience. In the case of wipes it can range from plastic-free, biodegradable and/or post-consumer content materials to carbon footprint reduction and zero-waste facilities. Disposability has been a primary advantage in the growth of wipes, but it also has the potential to curtail sales as those purchasing wipes become attuned to environmental concerns or the need to meet corporate sustainability guidelines.

Additionally, regulatory requirements will increasingly impact the material composition of wipes. For instance, from 2021 onwards, in the European Union, labelling requirements regarding the plastic content of wipes will push nonwoven producers and converters to favor fiber blends with less or no polyester or other synthetic components.

A trend in the consumer wipes market is the private label evolution. While competitive pricing remains one of the key propositions of private label, product selection has also been evolving to retain and grow the consumer base. Store brands offer scented and unscented varieties, products for sensitive skin, added ingredients for skin benefits (such as aloe vera and chamomile), as well as products positioned as natural.

Disposable wipe producers are also making changes to their **baby wipes** products to make them more attractive to consumers. Specifically, the drivers of growth for the baby wipes market—in addition to more babies—is the expansion of the premium baby wipes category, larger package sizes, more refillable packs, smaller portable packs, and advertising that targets the increased use of multiple baby wipes per baby change.

The growing premium baby wipes market has been propelled by a range of smaller players that have been entering the marketplace over the past several years, mainly in the premium and natural segments, which allows for better product differentiation from the main players. Priced at a higher level than the leading brands, many smaller players recognize their limited appeal and focus their strategies on the high-income households which are able to afford the products. Premium players also utilize a subscription model for more targeted distribution. This allows these brands to avoid direct competition from both cheaper products and leading brands, as well as supporting their premium image and brand equity.

Today there is a **home care wipe** on the market for almost every area of the home, yet new wipes in the home care category continue to be introduced, and increased product capabilities have allowed consumers to see added benefits with the use of wipes. Instead of using multiple bottles of cleaning solutions and creams and multiple sponges and towels to clean and polish the home, all that is needed is a wipe to get the job done. The fundamental drivers for home care wipes remain convenience and timesaving. The aging population will be another growth opportunity for household wipes given the wipes' convenience and ease of use.

Demand growth for nonwoven fabrics in **personal care wipes** has been dramatic in recent years, partially due to the fact that the category started from such a small base. This growth has been and will continue to be fueled by numerous product innovations—including the continuing advancements in flushable materials—and product introductions. These product introductions not only add new customers into that category, but typically attract a new set of consumers to the wipes market, most notably men and pets. In men's personal care there are now cologne scented, face/body deodorizing, scalp cleansing, post-shave healing balm, and beard wipes. For pets there are body & paw wipes, tooth & gum wipes and ear & eye wipes. Other recent product introductions include lush lip wipes, yoga mat wipes and nail polish remover wipes.

Industrial/Institutional Wipes

The industrial and institutional category can be classified several ways as there are dozens of end-use applications for nonwoven wipes. These wipes are classified into two broad areas: industrial/commercial and institutional. The industrial/commercial category is further segmented into general-purpose industrial/commercial and specialty industrial wipes. The institutional category is further segmented into healthcare/medical and food service/hospitality. Hospitality was added to the food service category to account for wipes provided in lodging establishments–hotels–and disinfecting wipes in other institutional locations, such as schools, recreational facilities, retail outlets, and government facilities.

Growth in the industrial and institutional markets is driven by the strength of the economy related to industrial production, product innovations, and expanding applications—and taking share from other materials, notably paper towels and laundered towels—for wipes in both the industrial and institutional markets. Nonwoven industrial wipes are forecast to continue taking share from laundered towels: towels sometimes leave behind lint, dirt and debris; using them can compromise a manufacturing processes and those contaminants can potentially get in the product being manufactured, resulting in rework. Towels used to wipe down industrial equipment can often contain debris like metal shavings. Towels also are often inconsistent in size, shape and material and occupy more storage space than disposable wipes. Nonwoven wipes are clean and consistent in quality, size and shape.

Continued gains will be seen in the healthcare segment as concerns of cross contamination, HAIs, and coronavirus-related mitigation efforts result in heightened demand for disinfecting wipes. Further, the convenience that wipes can offer—the standardized quantity of disinfectant per wipe which makes it possible for facilities to use them effectively and reduce waste—is driving growth. End-use segments, such as healthcare facilities, food service, and schools and universities, will continue to emphasize the importance of clean surfaces and hands in order to minimize germs and illness at their facilities.

Other drivers impacting the industrial and institutional markets are the concept of sustainability and companies adopting zero-landfill goals. There is an increasing focus by companies on sustainability. Sustainability reporting is increasing and International Organization for Standardization (ISO) certification is now available in regard to sustainability (ISO 14001: Environmental Management System). Government entities are also mandating the use of green cleaning products. The impact of these drivers on the industrial and institutional wipes markets is currently unknown and is an issue INDA and EDANA will be watching.

Another issue impacting the industrial/commercial market is shrinking cleaning budgets and its impact on the market. There is an opportunity for wipes to meet currently unfulfilled market needs and to provide cost-effective, multipurpose products for commercial and building service contractors.

Region View

As with absorbent hygiene products, increasing disposable income leads to rising expenditures or consumer spending for wipes production in the emerging and developing markets.

In 2010, production in the wipes market was relatively similar in North America, Greater Europe, and Asia. While the three regions all experienced strong growth due to strong demand in their regions and/or the opportunity to export, Asia's growth rate was higher (12.1%) and is now the largest wipes substrate producing region. The material is not all consumed in Asia, but some is shipped to other regions as either rolled goods or converted products (Table III-3 and Figure III-9).

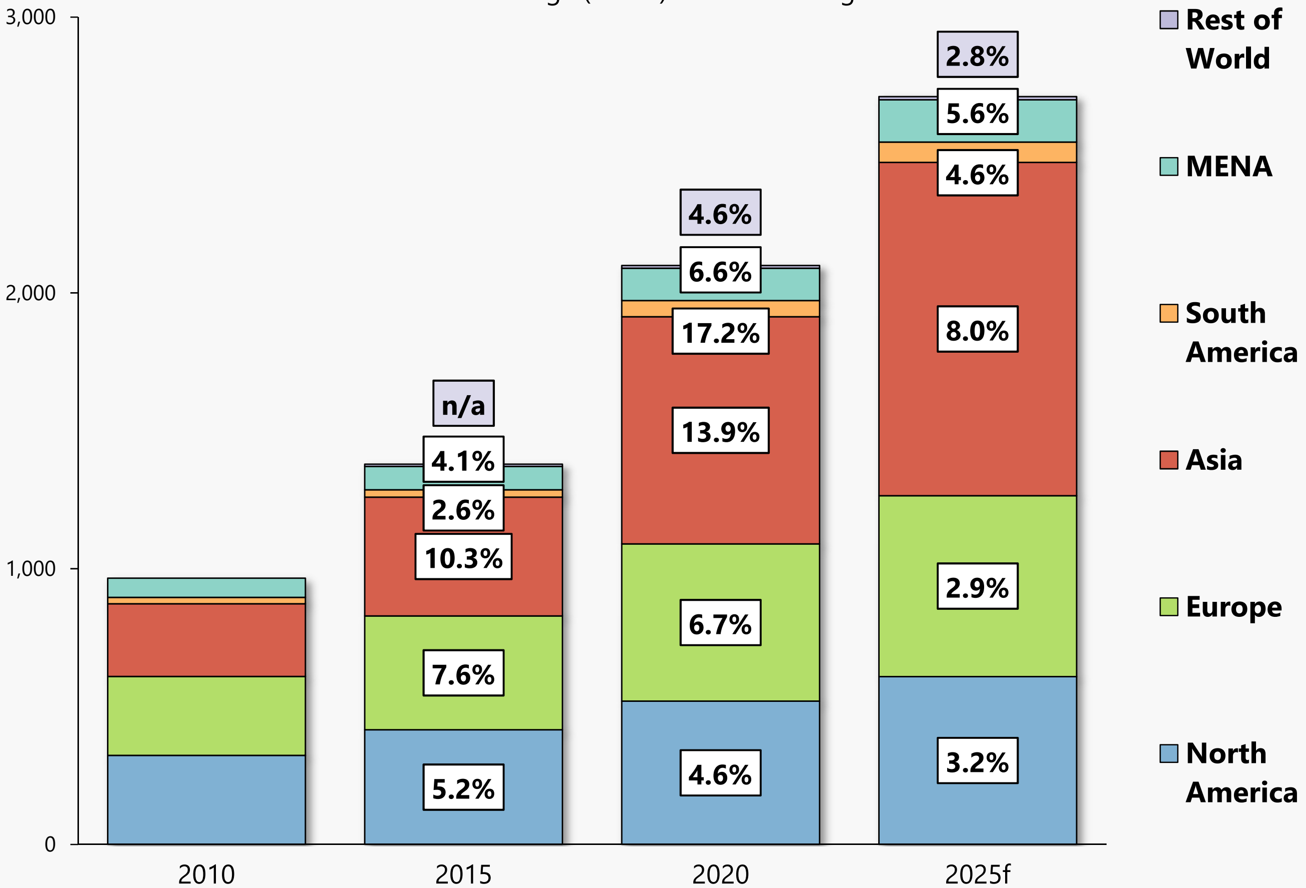
Asia not only led the regions in historical growth, but also in the forecast annual growth rate (8.0%) and in incremental tonnes (384,300) through the forecast period. North America and Greater Europe record the next largest amounts of incremental tonnage in the forecast period, adding 89,300 and 86,000 tonnes respectively (Figure III-8).

Figure III-8

Wipes Nonwovens Production by Region

(Thousand Tonnes)

Annual Percent Change (AAGR) from Preceding Five-Year Period



Source: INDA/EDANA/ANFA estimates, 2021

Similar to the absorbent hygiene nonwoven global production, Asia's production share has increased, though not to the extent of absorbent hygiene nonwoven production. In 2010, Asia's share of wipes nonwoven production was 27%; by 2020 that share rose to 39% and is forecast to add another 6 percentage points by 2025. At the same time North America and Europe went from each having a third of the production in 2010 and having dropped to around 25% each (Figure III-9).

Figure III-9

Wipes Nonwovens Production Share by Region

(Tonnes)

Source: INDA/EDANA/ANFA estimates, 2021

North America

Mexico is still an emerging market for wipes consumers, accounting for 13% of the consumer wipes purchased in North America. Baby wipes are the dominant consumer wipes purchased in Mexico. In 2015, 70% of the consumer wipes purchased in Mexico were baby wipes. Personal care wipes are gaining popularity in Mexico, as the share of baby wipes purchased dropped to 65% of the total consumer wipes purchased in 2020. As home care and personal care wipes continue to gain popularity and increase their share of the total wipes market in Mexico, the baby wipes share is forecast to drop to 60% by 2025.

A trend in the consumer wipes market is the private label evolution. While competitive pricing remains one of the key propositions of private label, product selection has also been evolving to retain and grow the consumer base. Store brands offer scented and unscented varieties, products for sensitive skin, added ingredients for skin benefits (such as aloe vera and chamomile), as well as products positioned as natural.

Discount stores that primarily stock only private label are expanding across the United States. Discount grocers including Aldi, Lidl, and Dollar General are collectively planning to open thousands of new stores over the next couple of years. Lidl will be a private brands leader in the U.S., considering that 90% of its assortment comes from private brands. At the same time, tech companies like Amazon—with its recent acquisition of Whole Foods—will also be entering the private label wars.

Greater Europe

Within the EDANA statistics, the wipes market is split into three main categories; personal care, household wipes and industrial wipes. EDANA has noted weight reductions have occurred in this market segment as well. Even if the wipes personal care category may still include a wide range of different types of wipes, the overall average weight of these materials has been around 42.75 gsm in the last decade.

Asia

Wet wipes did not appear in China until 1985 and began to develop rapidly in 2003 after the SARS outbreak.

According to the China National Household Paper Industry Association (CNHPIA), baby wipes and general purpose wipes accounted to 84.2% production in 2017 (most recent available data). The kitchen cleaning wet wipes and toilet wet wipes markets have been a recent focus of local producers. Dry soft wipes, favored by consumer, is one of the faster growing segments. The household cleaning and industrial wipes markets are still relatively small.

Filtration

Filtration—a separation process with a filter medium—has become so important that it can be found almost everywhere. The filtration segment includes nonwoven media for air and liquid filtration. The filtration end use is the fifth largest (in tonnage) of the nonwoven segments, consuming 9% of the world's nonwovens production in 2020, and will increase its relative share through the forecast period, with filtration rising to 11% of nonwovens production in 2025 (Table III-1, Figure III-2 and Figure III-3).

There are numerous drivers affecting nonwoven filter media demand, though the over-arching global megatrend would be the demands for purer air and cleaner water, which are both the subjects of ever-more stringent legislation. The market for nonwovens in filtration media is also growing—due to nonwoven media being more economical and better performing—by taking share from woven and paper-based filter media.

Over the last few years there has been a steadily increasing demand for improved air quality, particularly indoors, whether in private, public or industrial areas. Emissions may come from a variety of sources, such as gases from interior materials, particles which enter a room via the external air supply or processes running within the room. Further complicating factors may be the small size of a room, too many people in the room and the restricted availability of fresh air.

Consumers are increasingly aware of the potential health and aesthetic benefits of water and air treatment systems and are more willing to invest in these products to improve the environment inside their homes. Media reports about water and air contamination affect consumer perception about local water or air quality and thereby drive sales.

Economic and population growth will increase demand, which will require increased production and increases in manufacturing efficiency for industrial products, foods and beverages, and transportation, all of which means an increased need for filtration media. As the housing recovery strengthens and consumer spending activity continues to improve, so will consumer spending on water and air treatment systems. Rising home sales will also drive sales, since many consumers purchase or upgrade water and air treatment systems once they move into a new home. As the economy strengthens, consumers should return to replacing their existing filter products closer to the recommended replacement periods. Continued trends toward the incorporation of "smart" features and complementary monitoring devices indicating filter replacement time and toward specialized, industry-specific filtration media will support unit growth.

The filtration market is a diverse one with seemingly endless categories. Filters allow us to cleanse the air we breathe and purify the water we drink. Filtration in the food and beverage industry removes impurities and extends the shelf life of the products we consume. Medical filters can safeguard sterile environments like operating rooms by keeping out harmful pathogens and bacteria. Filters in vehicles make them more efficient, and more importantly, protect them. These needs, along with government regulations and environmental concerns, have put the filtration market on a path of continued growth.

The filtration-market customer base is the most diversified of all the nonwoven end use categories, with more than 30 major market segments with filter needs that vary in size from four story filter houses with up to 1,800 filters down to blood filters.

The **main drivers** of filtration product demand include

- the economy… vehicles sold, buildings built, products sold;
- increasing urbanization; dense population centers increase spread of germs and create higher concentrations of dirt and contamination;
- growing industrialization and its associated filtration needs;
- consumer awareness and sensitivity; and
- governmental legislation and regulatory control.

Secondary drivers include

- filter efficiency improvements;
- use of nanofibers and composite media technology;
- internet of things (IoT); and
- increasing share of filter media from other materials.

These drivers and developments have resulted in the nonwoven filtration market consuming an ever greater amount of nonwoven material, reaching 1.620 million tonnes in 2020, an annual increase of 7.4% from 2010. By 2025 the nonwoven filtration end use will consume an additional 598,000 tonnes (119,500 tonnes annually) reaching 2.217 million tonnes, a 6.5% annual growth rate (Table III-4 and Figure III-3 and Figure III-5).

The last issue of the Worldwide Outlook for the Nonwovens Industry forecast nonwoven filter media production to increase 6.2% annually from 2018 through 2023. This is very comparable to the 2015 through 2019 actual annual growth of 6.6%.

Table III-4

Filtration Nonwovens Production by Region

(Thousand Tonnes)

Region	2010	2020	2025f	Growth (AAGR) 2010-2020	2021-2025
North America	359	637	790	5.9%	4.4%
Greater Europe	147	234	285	4.7%	4.1%
Asia	258	655	1,015	9.8%	9.1%
South America	22	88	108	14.8%	4.3%
MENA	3	4	15	2.5%	29.9%
Rest of World	0	2	5	n/a	n/a
Total	**790**	**1,620**	**2,217**	**7.4%**	**6.5%**

Source: INDA/EDANA/ANFA, 2021

There have been technological advancements in developing new and innovative filter media over the past few years to meet all these demands, some of which were driven by government regulations. Nonwoven producers continually work to improve the efficiency (ratio of particles trapped by media over total particles upstream of media) of filter media which enhances the removal capability of both particulate and chemical contaminant. This has resulted in filter manufacturers increasing the range of spunmelt nonwoven materials, incorporating nanofiber layers or coatings, using fibers with integrated functional additives in nonwoven filter constructions, and developing hybrid fiber/material composite materials—all while optimizing the media structure and element configuration by computational modeling. Some examples of hybrid structures are Donaldson's Synteq XP filter media which contains a proprietary blend of polyester and glass fibers, which is thermally bonded in a proprietary process. Similarly, Johns Manville is now producing a thermally bonded bicomponent spunbond with a PET core layer and a melt polymer (other PET, PP or PE) sheath that bonds the PET fibers together at each crossing. These PET spunbonds are in turn being combined with glass mats for the latest advanced filter media for automotive fuel and oil filtration applications.

This is in addition to the ever-present demand of sustainability, both in terms of lower energy consumption and renewable raw materials and in the development of economically and ecologically effective disposal/recycling solutions for filters and filtration residue.

In addition to filtering, nonwovens can be engineered to offer benefits for many applications, including the removal of a wide range of contaminants, a uniform structure, tear and puncture resistance, chemical resistance, high retention capacities, high air permeability, excellent abrasion resistance, flame retardancy, the absorption of fats and oils, a high level of flow capacity, and high tensile strength. Nonwovens are especially suitable for filtration because of their complicated, often randomized, three-dimensional (3D) structure and thickness, which results in higher filtration efficiency than either woven or knitted fabric that generally have a 2D structure. Moreover, a nonwoven fabric can be constructed with various layers. In liquid or air filtration, for instance, an initial coarse open fabric removes larger particles, and as the fluid or airstream passes through the filter, the fibers and pores become smaller to trap ever-finer particles.

There is a demand for higher levels of filtration in virtually all fields of application for nonwoven filter media, and this demand is often being achieved with nanofibers. The ability to reliably manufacture materials at the nano-scale has created product development opportunities not previously possible. The launch of new nonwoven products enabled by nanotechnology is increasing in pace as the understanding of the properties and benefits continues to rise. Applications that will benefit from nanofiber integration are those where high surface area combined with little additional volume or weight is desired. Air filtration end uses range from residential to industrial HVAC systems as materials with nanofibers achieve higher levels of filtration efficiency at reduced pressure drops.

In most regions, transportation is the biggest market for nonwoven filter media, as it uses both air and liquid filtration, the two segments of the filtration market. The average passenger car or truck contains more than 30 filters which perform various functions including improving the performance of the engine; removing contaminants in the oil, fuel, and transmission systems; and improving the quality of air in the cabin. Other filter applications include in-tank fuel filter element, tank breather filter, brake hydraulics filter, chassis hydraulics filter, steering hydraulics filter, transmission oil filter, urea filter for SCR catalytic converters, fuel cell filter, oil filter, oil mist separator, bypass oil centrifuge, washer fluid filter, inline fuel filter, coolant filter, brake due particle filter, engine air filter, and cabin air filter. Computerization of the engine has also added filters to protect the electronic components. In the first five years, an average passenger car will have some of the filters changed three to five times. Alternative fuel vehicles may being to erode the dominance of the internal combustion engine; while these vehicles will not require the same filters of an internal combustion vehicle, they will still require new and distinctive advanced filter media, such as gearbox oil filters for electric axles, as well as cooling air particle filters for high voltage battery systems.

Nonwoven filter media is used for the filtration of engine air, cabin air, oil, and fuel. The increasing demand for vehicles is projected to continue through the forecast period, which in turn, will create the requirement for nonwoven filter media. Better economic situation and shift in lifestyle along with the rising consumer confidence have resulted in the increasing demand for new, fuel-efficient, and technologically advanced cars. Additionally, the easy availability of financing options is also driving people to invest in cars. This will fuel the growth of the automotive industry, which is identified to be one of the primary factors driving the growth of this market.

Much of the filtration market demand is based upon replacement; that is, filters are exchanged after a useful service life. This feature is a factor across the consumer, commercial, and industrial filtration markets, though it is in the consumer end uses that, given tighter economic times, consumers may have used filtration products past their useful life in order to save money.

Air and Other Gas Filtration

Cleaning and the purification of air is required in homes, hospitals, commercial buildings, and in hundreds of industries. Air and other gas filtration products include filters for vehicle air intake/induction; vehicle cabin air; commercial air systems, including medical and industrial controlled environments; industrial/manufacturing dust collection systems, including baghouse filers, turbine air intake, industrial pollution control, including exhaust and flue gas; residential heating and air-conditioning (HVAC) systems; personal protection such as face masks and respirators; and vacuum cleaner bag filters.

A significant boost to the air filtration markets will be the coronavirus-related mitigation efforts. Consumer and workplace health and safety is creating new filtration needs, and is raising the bar on performance. The assumption is that the filtration industry will be able to deliver the needed filters and masks. The air pollution prevention benefits of masks, HVAC filters, and dust collectors are also greater due to the steady increase in wildfires. Concerns that media manufacturers have about building capacity which will go unused after a vaccine is perfected is somewhat unwarranted. Not only are there non-mask uses but air pollution, indoor pollution, wildfires, and new viruses will boost mask demand.

Liquid Filtration

Liquid filtration is more than just water; liquid filters are also employed over a wide variety of fluids and applications. As with the air filtration industry, the liquid filtration market captures a wide variety of end uses. INDA has categorized the category into filters used, in tonnage order, for transportation (oil, lubrication, fuel, and transmission filters), industrial and manufacturing (high technology, hydraulics, hydrocarbon processing, and industrial processes), water (industrial processes, swimming pool/spa and water treatment), food and beverage processing (bottled beverages, coffee filters, cooking oil, milk, tea bags and other aqueous foods and beverages) and healthcare (biotechnology/ pharmaceutical and blood). Liquid filtration applications tend to be concerned with the filtration of either aqueous or hydrocarbon fluids.

In addition to this assortment of end uses, liquid filtration makes use of numerous filter types, including membranes for which the nonwoven is only providing support. A much wider range of equipment is used for liquid filtration than for air. In fact, almost all air filtration is achieved by some kind of replaceable filter element held in an appropriate housing.

Liquid filtration based on nonwoven media is generally not considered an absolute method of purification because particles of 1 μm or less in size can pass through the media. In many applications where sub-micron containments are present, further separation is required. Membrane- and nanofiber-based filtration and separation processes employ a membrane or nanofibers layered onto a nonwoven support which increases the strength and improves the particle-retention capacity. Some of these membranes are so thin and fragile that they can only be produced by directly being coated onto the nonwoven carrier's surface.

Demand for liquid filters is as varied as the end uses, though some of the more common drivers are:

- Transportation filtration is driven by the absolute increase in the number of vehicles driven and produced in North America, though slowed by longer service intervals.
- Industrial and manufacturing usage is driven by an increase in membrane usage, wastewater regulations, and the need to streamline the manufacturing processes to boost efficiency and improve carbon footprint. Metal catalysts are commonly used in chemical processes to speed the rate of reaction, the catalysts are consumed

in the process, and it is desirable to recover them for reuse—in particular, as gold, platinum and palladium can be costly. In many of the manufacturing processes, filtration is critical for the protection of downstream equipment to keep the machines running and free of costly repairs.

- Hydraulic filters in heavy machinery and equipment is driven by tighter tolerances required for finer filtration.
- Hydrocarbon processing is driven primarily by the oil and gas industry through hydraulic fracturing, offshore drilling, and the enhanced recovery of resources.
- High technology is driven by semiconductor products and the need for ultrapure fluids. Semiconductor plants use CMP (chemical mechanic polish) for the manufacture of silicon wafers. The particles in the slurry perform an important function of acting as an abrasive, but if oversized particles are present, they can scratch and gouge, rather than polish.
- Water filtration is driven by the demand for clean water and an aging infrastructure.
- Food and beverage processing is driven by health, safety and government regulations, in addition to increased demand with an absolute increase in population.
- Healthcare is driven by health and safety concerns. Pharmaceutical and biotech manufacturing demand ingredients that are free of not only particles, but also minute microorganisms.

Region View

Like the nonwovens wipes market, average annual production growth in the filtration media market grew faster than the overall global average, increasing 7.4% annually in the last decade (2010–2020). Also, like wipes, filtration production will be positively impacted by the COVID-19 pandemic, causing production to grow at a faster rate, than if the pandemic hadn't occurred, as there is a greater awareness of the benefits of clean air.

Asia, in tonnage once again, was one of the fastest growing regions, adding an additional 397,000 tonnes of production for filtration, a 9.8% annual growth rate through the historical period (2010–2020). As with many of the end uses, the material produced in Asia is not all consumed in Asia, so while some of the growth rates in a region may look slow (or large), that number does not take into account imports (or exports) and actual consumption in the region. Asia is forecast to add 359,200 tonnes of incremental tonnage through the forecast period, North America 152,700 tonnes, and Europe 51,400 tonnes (Table III-4 and Figure III-10).

Ongoing investments in water, wastewater, and power generation infrastructure will also support the global filter demand, particularly in emerging and developing markets.

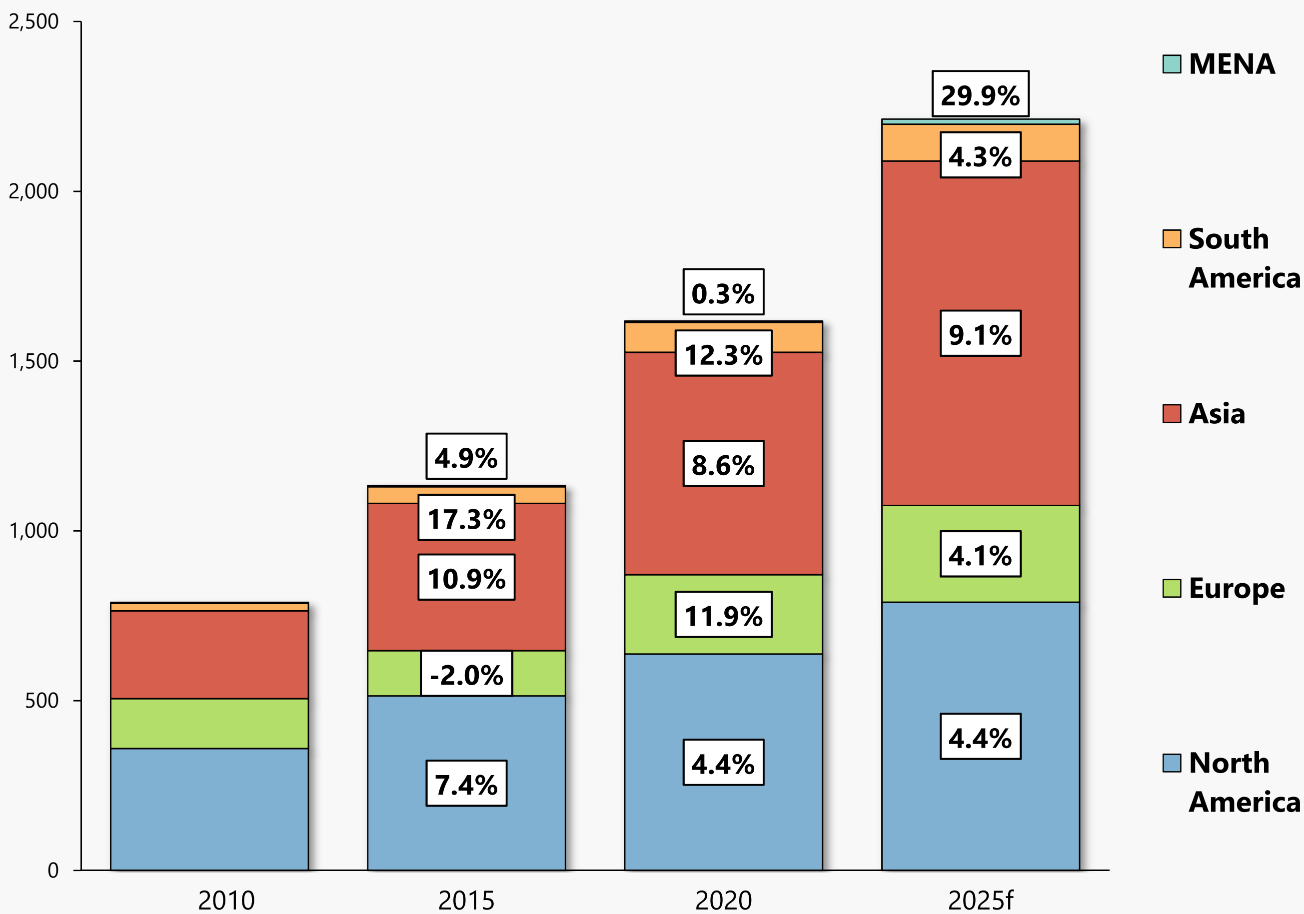
Further, in the emerging and developing markets, as personal income levels rises, residents will spend more on their personal health, leading to more home water and air purification equipment purchases. The aftermarket for filters will also benefit from more widespread knowledge about health and the need to replace filters more often.

Figure III-10

Filtration Nonwovens Production by Region

(Thousand Tonnes)

Annual Percent Change (AAGR) from Preceding Five-Year Period



Source: INDA/EDANA/ANFA estimates, 2021

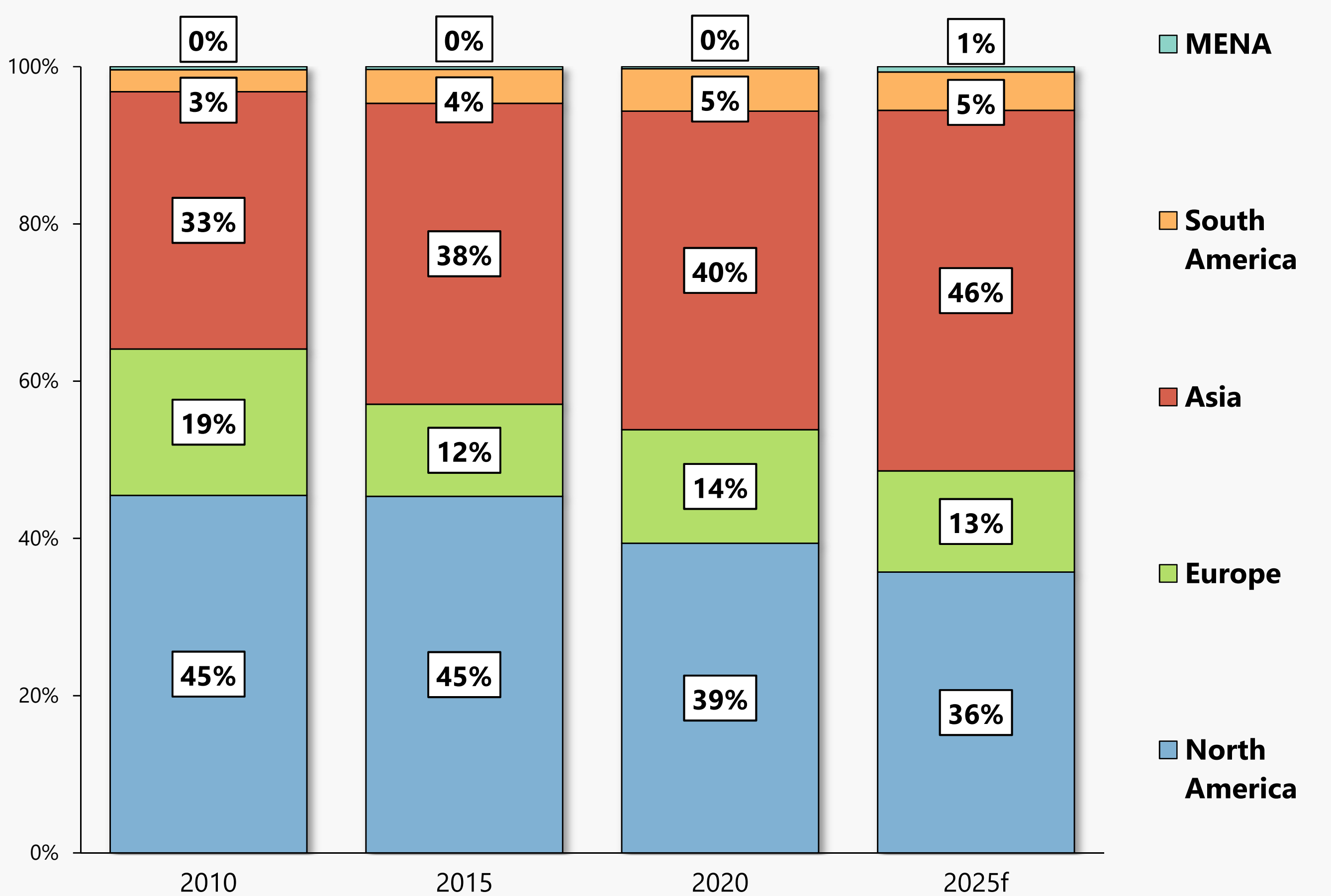
In 2010, North American accounted for nearly half (45%) of the world's nonwoven filter media production, followed Asia (33%) and Greater Europe (19%). Unlike some of the other nonwoven end-use categories, while Asia's production has grown, it has not captured a significant amount of the production share. Asia's share increased to 40% in 2020, while North America's dropped to 39%. By 2025 the Asia region is forecast to have the largest share in nonwoven filter media production, rising to 46% and North America dropping to 36% (Figure III-11).

One reason why North America continues to maintain it's share is the significant number of large wetlaid lines producing, glass fiber, glass/synthetic fiber blends, and cellulosic/ synthetic fiber blends producing filter media.

Figure III-11

Filtration Nonwovens Production Share by Region

(Tonnes)



Source: INDA/EDANA/ANFA estimates, 2021

North America

In the United States, new legislation and regulatory controls are increasing at local, state and national levels in regards to air and water quality. Enforcement of these regulations by the Environmental Protection Agency (EPA) and other agencies has increased the demand for products that limit emissions and has increased demand for products that protect people from the effects of emissions.

In North America just over half (52%) of nonwoven filter media production in 2020 was consumed internally by the producer and converted into a filtration or intermediary product. Examples of these companies include 3M, Cummins, and the Pall Corporation.

Greater Europe

As with North America, much of Greater Europe has regulatory controls that drive filter usage, both from national governments and the European Union. The increased use of domestic and institutional indoor air cleaning devices will further drive growth too.

Asia

The region's demand for filter media is based on the need for air purification products for automobiles and coal-fueled powers plants, as well as for liquid filters for treating municipal water and waste water. Filter demand will be boosted by efforts to reduce air and water pollution, such as more stringent vehicle emissions standards in China and India that approach those issued in Western Europe.

Severe air pollution in countries such as China and India has led to a revamp of policies and implementation of stringent air pollution standards. In China, stricter emission standards for flue gas and dust mean that finer—and more expensive—filter media are now being mandated. Not only are new filters being installed in both new and existing plants, but the new standards are requiring them to be replaced more frequently.

Growth in manufacturing output, building construction spending, and other industrial activities will also drive filter sales. The market for consumer filters will be expanded greatly by urbanization.

Medical

Used to prevent infection and maintain hygiene, medical nonwovens encompass everything from surgical drapes and gowns to wound care dressings. Health care workers face the risk of contracting life-threatening infections and diseases as a result of exposure to patients' blood and body fluids. They are also at risk of exposure to hazardous substances which may cause skin irritation.

These benefits have been brought to the forefront as the nonwovens industry responded to the need to protect healthcare workers and other medical professionals during the COVID-19 pandemic. There is still an intense focus on creating a sterile environment—particularly given the coronavirus outbreak—with opportunities for manufacturers to provide nonwoven medical and surgical products to meet this need.

Disposable nonwoven medical and surgical products are preferred by end users due to their excellent barrier properties—microbial and blood-borne pathogen penetration resistance—and reasonable costs, in comparison to reusable and laundered textile medical products; however, much of the world uses laundered products. Single-use nonwoven medical and surgical products offer consistent quality and dependability with each use, unlike reused and laundered textile products.

Since nonwovens are an engineered fabric, they can be designed to be absorbent or repellent (hydrophilic or hydrophobic), breathable or impervious, with or without film lamination to be soft (without) or stiff (laminated). Nonwovens can also be chemically treated to prevent water, blood, or bacteria from seeping through the fabric. Chemical performance enhancement can improve properties for moisture transport (absorbency or repellence), flame retardancy, and abrasion resistance. In addition to these chemical enhancements, recent advances in nonwovens have included the introduction of antimicrobial agents to their aseptic barrier properties.

Moreover, they can easily be disposed of by incineration. While incinerating on site is a benefit, it is also a barrier if a facility—such as many of those in the emerging and developing markets—does not currently have an incinerator or the financial means to install one.

The nonwoven medical and surgical products category includes surgical packs (disposable surgical gowns, drapes, table covers, and other parts), operating room/ surgical gowns; other apparel (isolation gowns, scrub suits, patient gowns, shoe covers, bouffant/surgical caps, and bedding); sterile packaging and sterilization wrap; and wound care (comprising of non-implantables, such as surgical gauze including pads, sponges, surgical tapes, wound dressings (primarily non-adherent dressings), undercast padding, and wound dressings; and implantables, such as tissue structures, sutures, and orthopedic structures).

As delineated in this sections introduction, there may be some issues of what is included in the medical category, specifically material for face masks and respirators. Given the significant growth in the medical end-use it is best to have an understanding of what is included in this end-use. EDANA includes face masks, assumed to be medical face masks, in the medical category. It is also thought the Asian associations have also included face masks in the medical category. INDA includes pleated nonwoven face masks and respirators in the personal protection category in filtration.

While much of the material produced in response to the pandemic was for medical markets, that is typically not the case. Pleated nonwoven face masks include those sold at the consumer level and those used in industrial, commercial, and healthcare environments. Furthermore, respirators range from full hood to full- and half-face pieces to disposable half masks covering just the mouth and nose. The long-life respirator masks typically have replaceable-nonwoven cartridges. The respirator market includes both medical respirators and industrial respirators. The disposable industrial respirator market is larger than the disposable medical market. 3M, one of the world's largest respirator producers, stated that prior to the pandemic, 90% of its respirators went to industrial uses, but that ratio, obviously, flipped during the pandemic as they have proven key to protect essential workers.

Another issue—in the medical end use—is in comparing annual growth rates, as the impact of COVID-19–and the corresponding increase in production—occurred at the end of the historical period and the beginning of the forecast period. Typically, nonwoven manufacturers can produce material for multiple end uses when the pandemic caused a considerable demand for medical apparel, wipes, and face mask material, producers were able to decrease production in one end use and increase production in those. As a result, some of the historical growth rates, notably medical, are higher than they would have been without the pandemic. Likewise, the medical forecast growth rates are lower and do not represent the underlying demand characteristics, given the significant amount of production in 2020.

It is important to keep those two issues in mind as you review the medical section growth rates.

The nonwoven medical end-use segment typically was one of the smaller nonwoven end-use segments, with medical accounting for 6% of the global nonwoven production in 2010; as a result of the pandemic that share shifted to 14% in 2020 (Table III-1 and Figure III-2).

Notwithstanding COVID-19, globally the medical market is **primarily driven by replacing laundered products** and for the developed markets, an **aging population**. As people age, chronic illnesses become more common and the use of ambulatory and inpatient health care increases.

The **main drivers** of nonwoven medical and surgical product demand thus include

- share from other materials (increase of disposable nonwoven apparel to laundered ratio);
- an aging population;
- number and types of surgeries, including births; and
- increased awareness and focused reduction and prevention of infections.

Secondary drivers include

- health economics (the direct and indirect costs associated with an infection versus the cost of prevention); and
- a higher propensity of chronic diseases—heart disease, stroke, cancer, chronic respiratory diseases, diabetes—infections and obesity, not to mention the potential for another pandemic outbreak.

In 2020, 2.480 million tonnes of nonwovens were used for medical and surgical products, an annual increase of 16.4% from 2010. However, the production in 2019 was 794,000 tonnes and the annual increase from 2010 to 2019 was 4.3% (and 5.0% 2015 through 2019), a more realistic historical growth rate number to use. By 2025 the end use is forecast to consume 1.317 million tonnes, a decrease of 1.163 million tonnes or an annual decrease of 11.9%. But once again, let's take out the COVID-19 induced production bump and look at the growth rate from 2019 to 2025; this results in an annual growth rate of 8.8%, a more representative annual growth rate (8.8%), as opposed to a double-digit decline, given there will continue to be a focus on creating a sterile environment for both the healthcare provider and the patient (Table III-5, Figure III-3 and Figure III-5).

Table III-5
Medical Nonwovens Production by Region
(Thousand Tonnes)

Region	2010	2020	2025f	Growth (AAGR) 2010-2020	2021-2025
North America	287	279	310	-0.3%	2.2%
Greater Europe	58	169	167	11.3%	-0.2%
Asia	139	1,866	681	29.6%	-18.3%
South America	22	64	70	11.4%	1.7%
MENA	32	94	83	11.4%	-2.4%
Rest of World	4	8	6	7.2%	-5.6%
Total	**542**	**2,480**	**1,317**	**16.4%**	**-11.9%**

Source: INDA/EDANA/ANFA, 2021

The last issue of the Worldwide Outlook for the Nonwovens Industry forecast nonwoven medical production to increase 6.8% annually from 2018 through 2023. Depending upon the growth rates used this was either fairly accurate or way off.

There is a growing awareness on focused reduction and prevention of Healthcare Acquired Infections (HAIs). Healthcare Associated Infections (HAIs), also referred to as Hospital Acquired Infections (HAIs), are infections acquired anywhere health care is delivered, including inpatient acute care hospitals, outpatient settings such as ambulatory surgical centers and end-state renal care facilities, and long-term care facilities such as nursing homes and rehabilitation centers. HAIs can be caused by infectious agents, including bacteria, fungi, and viruses as well as other less common types of pathogens. Research has shown that a significant portion of these infections can be prevented, and at least half of HAIs can easily be avoided. The focus and attention on HAI reduction will lead to higher compliance with recommended guidelines and procedures. The increased compliance—along with demand for disposable nonwoven medical products—is forecast to increase through the forecast period.

While there are global megatrends—aging population, infection reduction, higher propensity of chronic diseases, and increased nonwoven to laundered ratio—supporting the industry growth and creating numerous specialized opportunities, there are also potential market restraints. There are also trends that could potentially restrain growth:

- Continuing trend of less invasive surgeries, be it outpatient surgeries or advances in exploratory options. For example, many cardiovascular and orthopedic procedures are now done in an outpatient setting at an ambulatory surgical center

(ASC), bypassing the need to use a full operating room in a hospital. While medical and surgical products will be used in these smaller operations, they do not require the number of apparel items that would be used in a full operation. Surgical packs can also be specialized for specific operations that may require fewer or smaller-sized pack parts. There has also been an increase in the use of technology for diagnostic procedures, such as magnetic resonance imaging (MRI), computerized axial tomography (CAT) scans, and radiology testing to determine the cause of pain or illness, rather than subjecting the patient to an exploratory procedure under full anesthesia.

- Patient empowerment, as patients are becoming increasingly active participants in their own healthcare and opting for outpatient surgeries at the expense of inpatient surgeries, and when at the hospital, choosing to spend less time there.
- An increase in the number of robotic surgeries requiring less medical and surgical products. Within five years, one in three U.S. surgeries—more than double current levels—is expected to be performed with robotic systems, with surgeons sitting at computer consoles guiding mechanical arms. Most top U.S. hospitals for cancer treatment, urology, gynecology and gastroenterology have made investments for surgical robots and robotic arms. The robots are featured prominently in hospital marketing campaigns aimed at attracting patients, and new doctors are routinely trained in their use. Surgical robots are used in hernia repair, bariatric surgery, hysterectomies and the vast majority of prostate removals in the United States.

However, given these potential market restraints, there is still an intense focus—made more so by COVID-19 and other potential outbreaks—on creating a sterile environment, with opportunities for manufacturers to provide nonwoven medical and surgical products to meet this need.

Surgical Packs and Gowns

Single-use nonwoven surgical gowns and nonwoven drapes are mainly designed for specific procedures, meaning that they are ideal for rapid and easy draping and cleanup. Single-use surgical packs, typically by procedure, are not only meant for fast preparation and turnaround of the operating room, but also for smaller storage requirements than reusable textiles.

Bodily fluids and microorganisms can be dangerous sources of contamination in the operating room, putting surgical staff and patients at risk for bacterial and viral transmission. Surgical attire that is resistant to penetration by blood and other fluids can help minimize the risk of infection by preventing exposure. Surgical gowns offer high repellency, which protects the wearer against low-surface-tension liquids such as blood, body fluids, and alcohol.

Nonwoven materials were introduced for use in disposable surgical gowns in the 1960s to provide a more effective barrier against penetration by fluids containing microorganisms. Since the 1980s, the protective properties of gowns made from nonwoven fabrics have greatly improved thanks to advances in nonwoven material, coating and laminating technologies. Today these gowns may comprise multiple layers, and the combination of layers enhances overall barrier performance and strength while remaining permeable to air and moisture vapor.

Surgical drapes are used to drape a surgical patient to eliminate the risk of surgical site contamination by separating the surgical site from the remaining part of the patient's body, as well as from non-sterile areas of the surgical table. Surgical drapes provide protection from various sources of contamination growing or originating from within an organism such as skin flora. Surgical drapes range from absorbent to repellent, delivering high levels of protection. Impervious and absorbent drapes made from nonwoven and film laminate fabrics are designed for the most demanding surgeries, creating a total barrier to bacteria and viruses.

Both nonwoven surgical gowns and drapes tend to have little to no lint, further avoiding a potential risk of infection.

Other Apparel

Other medical and surgical apparel includes apparel that is worn during surgical procedures by the surgeons, staff, and patient, but is not included in surgical packs. This category also includes apparel worn outside of the operating room. These products include isolation gowns (for nonsurgical applications and those in great demand during the pandemic), scrub suits (worn in the perioperative environment prior to donning surgical gowns and entering the sterile operating environment), patient apparel (x-ray/exam gowns), caps, shoe covers, and bedding (sheets and pillow covers).

Sterile Packaging/Sterilization Wrap

Central Supply Room (CSR) wraps are a product used when sterilizing surgical instruments. The procedure consists of wrapping the sterile wrap around a tray containing the operating instruments and then steaming the entire pack to sterilize it. Innovation and research continue to redefine sterilization standards and recommended practices, and surveying agencies are intensifying their oversight of these processes.

In the early 2000s, the market for sterile packaging wrap, including CSR sterilization wrap, had been declining as hospitals moved toward the use of prepackaged custom trays and rigid containers for surgical instruments. Further, the trends toward less invasive surgical procedures and out-of-hospital surgeries have reduced the consumption of CSR wrap. However, it appears that this decline was only a transition period, given advances in medical sterilization. Now sterile packaging and CSR sterilization wrap are growing at a rate similar to that of surgical procedures. Sterile packaging is also used in other healthcare settings besides surgical operating rooms, such as in dentists' offices.

The used-in-advance medical sterilization requires a complex balancing act that requires breathability technology and control, a balance that nonwovens provide. Sterilization technology is typically based on ethylene oxide. Ethylene oxide sterilization (EtO) requires that the pack be filled with EtO gas for internal sterilization and then be evacuated without permitting the ingress of bacteria.

Wound Care

The disposable nonwoven medical and surgical wound care market can be classified into two categories: non-implantables and implantables. The non-implantables are the traditional nonwoven wound care market of surgical gauze (pads, sponges, undercast padding and wound packing), surgical tapes, and wound dressings (primarily non-adherent dressings). Implantables include such products as tissue structures, sutures, and orthopedic structures.

The nonwoven wound care market is one of the most dynamic and innovative nonwoven categories, making use of the latest technologies, medical developments, and chemistry discoveries to engineer nonwoven fabrics thought unimaginable just 10 years ago.

Surgical gauze is used for a variety of purposes during surgery and topically. While surgical gauze is absorbent for absorbing blood and other body fluids, absorbency is not the only property needed. During surgery it is used for packing spaces and cavities, holding organs and body parts away from the point of interest, protecting organs and body parts from surgical instruments, cleaning organs and body parts, and, of course, absorbing excess fluid. Topically, gauze is used as secondary wound dressings, for cleaning and irrigating wounds, temporarily packing cavities, skin cleansing and temporary dressings (ambulances/first aid).

The traditional wound care dressing comprises three layers: the wound contact layer (a nonstick surface); an absorbing layer (absorbs fluids and provides cushioning); and the base (allows for application of the dressing to the wound, usually coated with a skin-friendly adhesive). Nonadherent dressings are ideal for open wounds that have light to moderate exudate. The nonadherent properties keep the fabric from sticking to the wound, even as the wound heals. Nonadherent dressings can be applied dry or are available saturated/impregnated with petroleum, petrolatum or other emulsions to aid in the healing.

The latest innovations can then be combined into wound care dressings by adding special coatings and films to the nonwoven fabric, or adding ingredients—including nanofibers, chitosan fibers, or super-absorbent fibers—into the polymer resins. Antimicrobial wound dressings can be manufactured by adding a bi-layer of silver-coated, high-density polyethylene mesh on a rayon adsorptive polyester core, to deliver nano-crystalline silver from a nonadhering, nonabrasive surface. The nanocrystalline silver provides highly effective antibacterial and fungicidal protection.

A small but potentially revolutionary development is in the area of nonwoven wound care implantables or biomedical textiles. Biomedical textiles are a subcategory of medical textiles that narrow the field to those applications intended for active tissue contact, tissue regeneration, or surgical implantation. Biomedical textiles tend to be designed as drug delivery mechanisms, scaffolds for tissue engineering, or both. Nonwovens tend to provide a greater surface area compared to other medical textiles, a characteristic which manufacturers can engineer through the material's spacing, integrity and thickness. These cutting-edge products include:

- Biodegradable drug-loaded fibers that can be produced in several formats including needlepunching.
- Nonwoven scaffolds—made from bioresorbable materials of natural or synthetic origin that can be absorbed by the body and seeded with stem cells—that boost cell growth before disintegrating to leave the natural tissue in place.
- Nonwoven scaffolds to position drugs exactly where they are needed in the body before they are released in a controlled manner;

- Nonwoven/film composites for transdermal application, i.e., dressings and patches that are placed on the skin to allow a drug to permeate directly to the required area, temporarily replacing the function of the skin by maintaining an antimicrobial barrier, while offering moisture vapor to pass through, thereby supporting the body's fluid homeostasis; and
- Other applications for dental, cosmetic, and orthopedic purposes.

Region View

Regionally, nonwoven medical and surgical products is the most varied category across the regions due to varying penetration rates across the regions and within the regions, such as within Greater Europe. Outside of the United States, Canada and Western Europe, there is still untapped potential in penetration of single-use nonwoven medical products.

Expansion of healthcare provisions and regulations in the emerging and developing markets will provide significant growth opportunities. Notably, in November of 2016, the World Health Organization issued its Global Guidelines On The Prevention Of Surgical Site Infection. No international evidence-based guidelines had previously been available before WHO launched its global guidelines, and there are inconsistencies in the interpretation of evidence and recommendations in existing national guidelines. While the guidelines do not specific state only nonwovens should be used they state "sterile disposable nonwoven drapes and gowns or sterile reusable woven drapes and gowns should be used to prevent SSI (Surgical Site Infection). This is a start in the right direction and continues to raise the awareness of preventing infections.

In the developed markets, nanofibers have a growth opportunity in medical and surgical products where high surface area combined with little additional volume or weight is desired, perhaps in the areas of wound dressings, bone scaffolding and controlled release drug delivery.

In 2010, the North America region had the largest medical nonwovens production across the regions at 287,000 tonnes, with Asia close behind at 139,00 tonnes (at that time China only accounted for 61% of the Asian medical nonwoven production).

Given the anomalies of 2020, the text will analyze the growth from 2010 to 2019. By 2019, Asia had passed North America, having grown 11.6% annually between 2010 to 2019, compared to North America's contraction of 1.8% over the same time. Part of the North

American business had transitioned overseas (China, Vietnam and the Dominican Republic), as cutting and sewing are involved. For some of the higher value material, the material is produced in North America and shipped out of the region to be converted and then shipped back to North America. Over a billion pieces of nonwoven surgical drapes and the trade-defined category of "nonwoven disposable apparel designed for use in hospitals, clinics, laboratories or contaminated areas" were imported into the U.S. in 2019.

The South America region also underwent strong historical growth, expanding 9.2% annually between 2010 to 2019, as nonwoven medical products began to gain traction in the region's major hospitals.

By 2025, Asia will account for half (52%) of the market. From 2019, it will add 308,000 tonnes of incremental capacity, equating to 59% of the total increase in incremental capacity (522,600). There has been some significant investment in the production of nonwoven medical and surgical products in the MENA region. The region is forecast to add more incremental tonnage through the 2019–2025 period (32,700 tonnes) than South America (22,000).

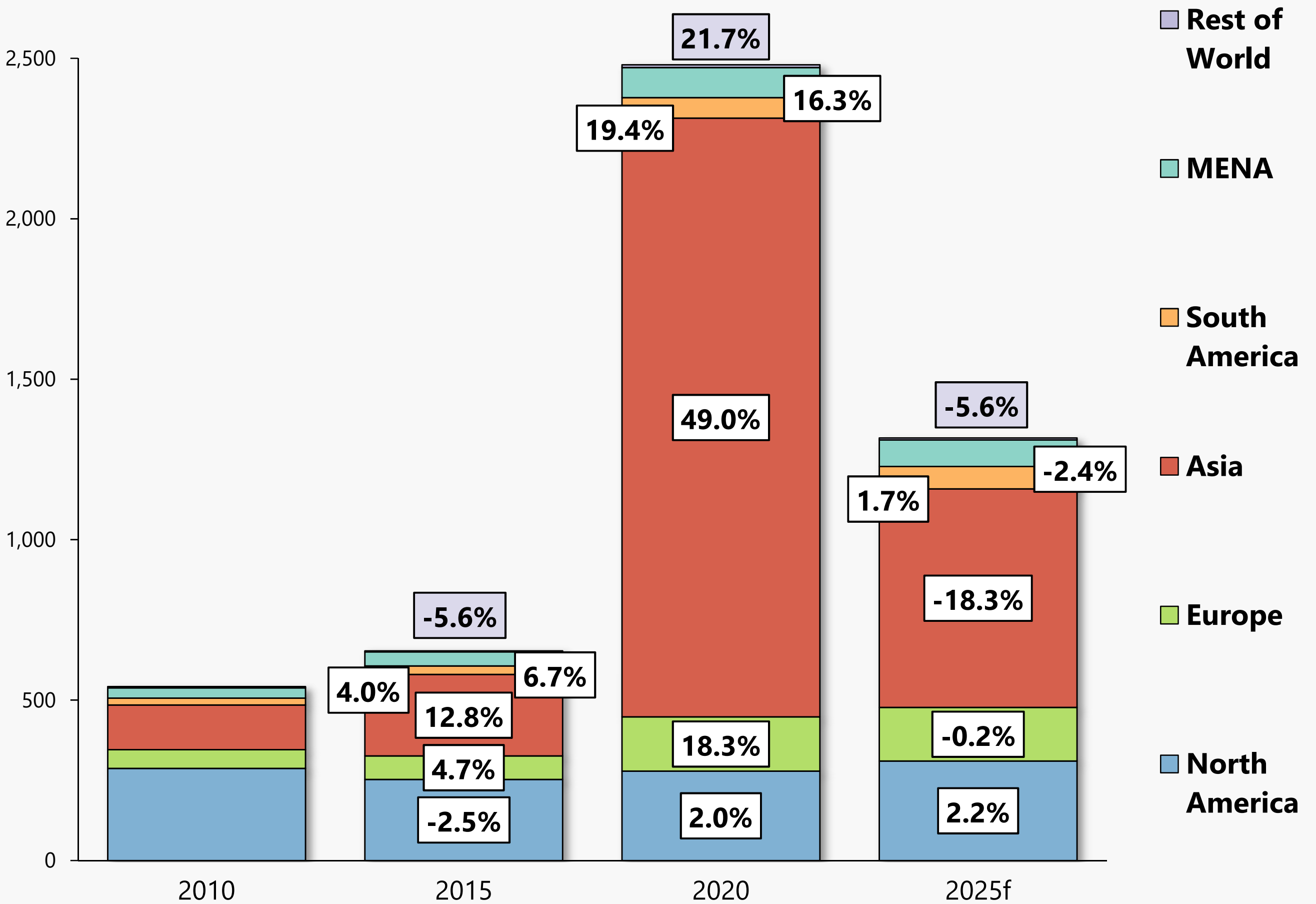
The following figure (Figure III-12) highlights the significant increase in Asian medical nonwoven production and corresponding drop the trendline growth rate.

Figure III-12

Medical Nonwovens Production by Region

(Thousand Tonnes)

Annual Percent Change (AAGR) from Preceding Five-Year Period



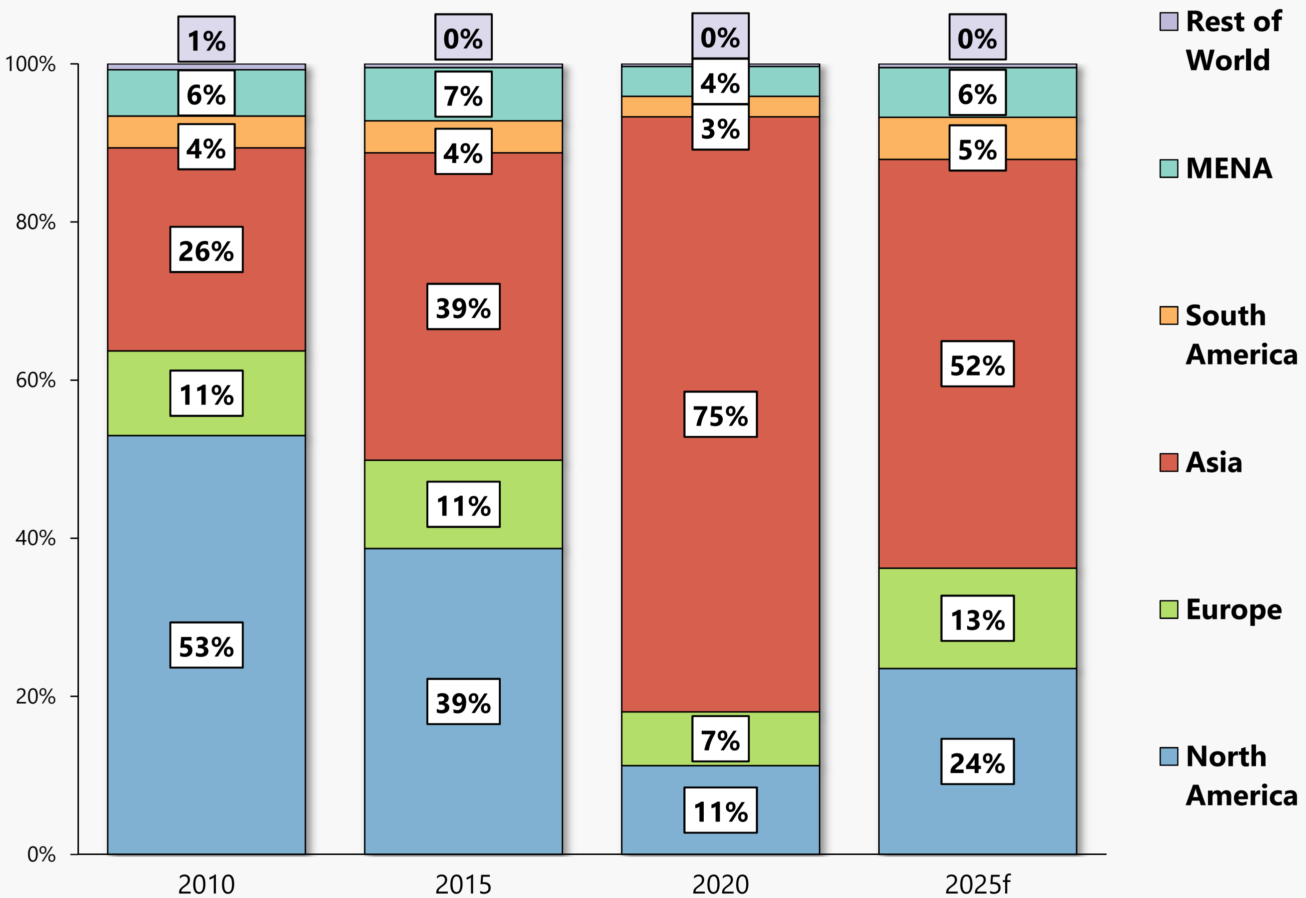
Source: INDA/EDANA/ANFA estimates, 2021

As mentioned in 2010, the North America region had the largest medical nonwovens production across the regions, and correspondingly, the largest share at 53% followed by Asia at 26%. Ten years later, as Asia ramped production for the medical markets, all of the other region's shares declined as Asia's share increased to 75%. Asia's share is forecast to decrease to 52% as Asian producers move production back to other end use, North America's share increase to 24% and Greater Europe to 13%, notably an increase over its 2015 share (Figure III-13).

Figure III-13

Medical Nonwovens Production Share by Region

(Tonnes)



Source: INDA/EDANA/ANFA estimates, 2021

North America

Many hospitals in the United States and Canada use both reusable and disposable gowns in surgical procedures. On the average, an estimated 95% of all surgical procedures use disposable nonwoven gowns and 97% use disposable nonwoven operating room drapes.

In North America, based on the underlying numbers—population growth, number of procedures at hospitals, births at hospitals and surgeries—medical and surgical growth is somewhat limited. However, there are megatrends–such as an aging population—supporting the industry growth and creating numerous specialized opportunities.

Imbalances in healthcare resources, a lower overall healthcare pricing structure and an installed laundered product base will continue to hold down total demand for nonwoven medical disposables in Mexico. The Mexican healthcare sector, as a whole, lacks the resources for constructing medical units and acquiring equipment (such as incinerators). The majority of medical and surgical textiles are reusable and laundered textiles, as opposed to nonwovens. Perhaps a third of the surgeries in Mexico use disposable nonwoven medical and surgical products, compared to 95% in the United States and Canada. Nonetheless, the country will provide opportunities for growth as access to basic healthcare services are upgraded and expanded to reach an increasing number of residents and a focus is placed on infection prevention.

Greater Europe

Single-use nonwoven medical and surgical products penetration rates vary greatly in Greater Europe from above 85% in the Nordic countries to below 50% in Southern and Eastern European countries. Growth potential lies in Central, Southern and Eastern European markets.

Asia

Some Asian countries, including China and India, are unique in that the patients' families provide necessary equipment—including apparel—to care for family members while in the hospital.

South America

A strong growth opportunity exists in South America with proposed regulations changing the requirements for healthcare providers and facilities.

Transportation

Nonwovens have proven themselves versatile in the transportation sector, saving resources and making vehicles quieter, lighter and more comfortable. Nonwoven composites are now being used to replace parts previously made of metal, in addition to replacing plastic parts. The key benefit of the composite components is their light weight; they can also be molded and produced with special surface finishes and other features. In addition, nonwoven materials can be made for sustainable material and some offer the ability of being recyclable.

Transportation is the category formerly titled "automotive," which included passenger cars and light trucks/SUVs/vans/crossovers. The new category of transportation additionally includes nonwoven-consuming heavy trucks/commercial freight vehicles, motor buses, recreational vehicles, commercial transport aircraft, general aviation, helicopters, recreational powerboats/sail boats, passenger rail cars, light rail cars, and trams/streetcars/trolleys. The transportation end-use category includes nonwoven vehicle carpet. However, the numerous filters used within the various transportation modes appear in the filtration end-use category.

The transportation end-use segment is the largest, in tonnage, of the durable end-uses and in 2020 was the sixth largest of nonwoven end-use segments (third in 2019), up from eighth in 2010. Transportation is now the largest of the durable categories, having passed building construction in 2017. Transportation or material for vehicle construction consumed 9% of the world's nonwoven material in 2020, an increase from its share in 2010, 6%. The second-fastest growing nonwoven end-use segment in the last decade is forecast to increase its share to 10% by 2025 (Table III-1 and Figure III-2).

The transportation market is **primarily driven by the economy** and by vehicle producers requiring lighter weight and better performing materials.

The **main drivers** of vehicle demand include

- the economy… total vehicles sold;
- government regulations in regards to fuel economy, and
- light weight material substitution and improved aerodynamics, including taking share from other materials.

Secondary drivers include

- growth in production on global platforms;
- improved driving experience for customers;
- parts consolidation—offered by composites—for producers;
- sustainable solutions;
- increased vehicle size; and
- pent-up demand (replacing aging vehicles).

With oil prices expected to remain at a relatively low level through the forecast period, gasoline price increases should be moderate. With moderate gas prices, the continued strong sales of larger vehicles such as trucks, pickups, SUVs, and crossovers are expected. An increase in the average vehicle size will further impact the amount of nonwovens used per vehicle.

However, while affordability might remove obstacles to purchase larger vehicles, legislative or taxation-driven requirements will continue to drive demand for smaller fuel-efficient and alternative fuel vehicles and the use of lightweight materials in all vehicles.

In 2020, tonnage consumed by the nonwoven transportation end use reached 1.570 million tonnes—nearly tripling in size in the last ten years—adding an incremental 999,200 tonnes of production from 2010. Nonwovens experienced significant growth in the past five years (notwithstanding the slowdown in 2020), as not only were more vehicles produced, but nonwovens have continued to take share aware from other materials (Table III-6, Figure III-3 and Figure III-5).

Table III-6

Transportation Nonwovens Production by Region

(Thousand Tonnes)

Region	2010	2020	2025f	Growth (AAGR) 2010-2020	2021-2025
North America	180	742	838	15.2%	2.5%
Greater Europe	99	156	207	4.7%	5.8%
Asia	253	578	863	8.6%	8.3%
South America	35	79	97	8.4%	4.1%
MENA	2	7	15	13.0%	18.1%
Rest of World	2	8	18	14.9%	17.6%
Total	**571**	**1,570**	**2,038**	**10.6%**	**5.4%**

Source: INDA/EDANA/ANFA, 2021

Transportation had the highest non-pandemic influenced annual growth rate across all the end uses and, in addition to medical, was the only other end use to reach double-digit growth, 10.6%. By 2025 the end use will consume an additional 468,000 tonnes (93,600 tonnes annually), reaching 2.038 million tonnes, a 5.4% annual growth rate (Table III-6, Figure III-3 and Figure III-5).

Our forecast in the last issue of the Worldwide Outlook for the Nonwovens Industry was on the conservative side compared to the actual growth rate. Even though in the last report we forecast transportation to have one of the higher average annual growth rates through the forecast period (6.2%, 2018–2023), the historical growth rate was higher (10.6%, 2010–2020 and an average annual growth rate of 9.5% from 2015 through 2020).

Consumers, industry and government authorities are today placing increasingly higher requirements on modern vehicles: optimum efficiency and a correspondingly low environmental burden coupled with a simultaneous enhancement of driving performance, safety and comfort are expected. Automobile manufacturers and suppliers work hand in hand to put appropriate solutions into practice. The focus of vehicle development lies in the use of **innovative and multifunctional lightweight materials** that not only reduce the vehicle weight and hence fuel consumption and emissions, but at the same time also provide highest possible noise protection. Much of this substitution is taking out heavy metal and plastics parts and replacing them with lighter weight products, such as composite material in door paneling, consoles, engine compartments, and the floor pan.

Automakers are under pressure to lower weights and take out heavy metal parts, replacing them with lighter weight products, such as composite material in door paneling, consoles, engine compartments, and the floor pan. Lightweighting is a concept in the auto industry about building cars and trucks that are less heavy as a way to achieve better fuel efficiency and handling. Automakers make parts from carbon fiber, windshields from plastic, and bumpers out of aluminum foam, as ways to lessen vehicle load, in addition to the use of nonwovens by themselves or as part of a composite. The focus of vehicle development lies on the use of innovative and multifunctional lightweight materials that not only reduce the vehicle weight and hence fuel consumption and emissions, but at the same time also provide highest possible noise protection.

Passenger vehicles have seen rapid evolution over the last few decades with an increasing focus on comfort, convenience, safety and the quality of the driver and passenger experience. Tactile pleasure and aesthetics, which were once the preserve of luxury vehicles, are now a basic requirement for every model. Superior silencing materials are required to enhance comfort in the car interior, which contributes to general well-being and safer, more relaxed driving. Meanwhile, higher engine temperatures and pressures place extra demands on silencing and sealing components.

Improving vehicle efficiency remains a priority for manufacturers and suppliers as they strive to meet government regulations and customer demands. Overall weight reduction is fundamental to this goal and, accordingly, manufacturers are focusing on materials that offer low weight along with high durability and comfort.

Transportation noise has been identified as the second most deadly environmental pollutant in Europe and is an important driver of vehicle development. Noise, Vibration and Harshness (NVH), as a field of vehicle technology, deals with two different areas of study. The first is interior NVH, which focuses on improving the interior vibroacoustic environment for drivers and passengers and protecting professional drivers against occupational health issues. The second is exterior NVH, which aims to control and reduce environmental noise emissions from vehicles and, simultaneously, ensure sufficient acoustic noticeability of electric vehicles to protect road users.

Nonwovens play an important role in noise reduction within the vehicle. Noises are generated from the engine, exhaust system, tires, and airstream. As vehicles become lighter and more powerful, powertrain noise is a key concern, and airborne noise is only part of the picture. Manufacturers produce acoustic products with a combination of nonwovens and/or other materials. Acoustic nonwovens can now be found on the exterior of vehicles and in the interior. Cars are getting quieter and quieter—so much so, in fact, that inexpensive cars today are now quieter than expensive cars were years ago.

While the benefits of using nonwovens for weight reduction are apparent, they may not be so apparent for drag reduction. The use of nonwovens as undershields, wheelhouse liners, and air intake tunnels can reduce the drag of a vehicle by as much as 10 percent.

As well as lighter weight for better fuel efficiency and lower emissions, there is a demand for sustainable and recyclable materials. However, it is notable that, while consumers are interested in more eco-friendly materials and manufacturing processes, they do not expect to compromise on fuel efficiency or on the feeling of quality, durability, luxury or safety.

Almost all the leading car manufacturers are following a trend of replacing metal parts with lighter materials in their vehicles, sometimes with composites. A composite is a mixture of two or more chemically different and insoluble materials. The structure that is formed shows superior properties and structural performance than the individual parts. Composites (carbon fibers, glass fibers, natural fibers, metal matrix, and ceramic matrix) have made a significant impact on the commercial aircraft and automotive markets. Using composites makes vehicles lighter, renders greater resistance to heat and external impact, and improves fuel efficiency. With extensive research and cost-effective mass production techniques now in place, the prices for composites have dropped and have resulted in a direct increase in their demand in the automotive sector.

All the leading Tier 1 automotive suppliers use nonwovens and/or nonwoven composites in some of their products to some degree. These nonwoven components are produced in a variety of combinations: thermoset nonwovens, high-loft nonwovens, needlepunched shoddy nonwovens, hybrid fiber blends (glass, polypropylene, natural fibers), and composites incorporating layers of nonwovens and/or other materials. Disparate layers (nonwovens, woven or knitted fabrics) can also be stitchbond—a nonwoven process—to provide unique physical characteristics.

Many of the components, specifically headliners and package trays, are of a composite construction, with the nonwoven material providing the outer surface and foam, cotton shoddy, high-loft, honeycomb cores, or other foam-type constructions adhered to the nonwoven. Nonwovens are also used to improve the stiffness of foam-based acoustic parts and provide visual appeal.

Car seat components are another example of a composite nonwoven in an automobile. Foam can be replaced with a laminate composite of multi-knit-nonwoven and woven fabric that can be stitchbond to provide unique fiber structure (vertically oriented fiber). These materials provide superior air permeability, recyclability, elasticity of compression, moisture absorption, and cost-saving options compared to conventional composite constructions.

Nonwovens are now used in almost every part of a vehicle. They dampen sound, provide insulation, reduce weight, reduce drag, and offer better end-of-life opportunities than traditional materials. Nonwovens can offer waste-free production due to the closed-loop direct feeding of remnants back into the manufacturing process.

Nonwovens provide weight and cost savings due to their versatility, functionality, and recyclability compared to other materials. Nonwovens can be tailor-made for the specific application through changes in surface treatments, weights, and fiber type. Nonwoven materials can be enhanced with different repellent and flame-retardant treatments. Nonwovens tend to be 15 to 30 percent lighter than the traditional materials they replace.

Nonwovens are also valued for their high-speed production, low cost, and easy-to-mold nature compared to other materials. Nonwovens are replacing extruded plastic parts because nonwoven technology can reduce the weight and offer better acoustical properties. All in all, nonwovens are gaining greater and greater acceptance in the automotive industry and, more importantly, with automotive designers.

Further, vehicles using nonwovens have a benefit of less impact on the environment. The growing awareness of environmental issues fosters a sustainable use of resources. Nonwovens help to cater to this trend by reducing weight and thus improving fuel economy. They increase the recyclability quota with a higher share of recycled raw materials. Additionally, more recycling during the production process and a higher recycling rate for end-of-life vehicles improves the environmental footprint of vehicles.

Generally, North America and other global regions have lagged behind Europe in adopting new technology—including the use of nonwovens—in vehicle uses. However, as companies have moved to global platforms—a set of common design, engineering, production, and components—the pace of nonwoven adoption has accelerated. New composites and other uses of nonwovens are introduced not with the yearly new models, but when the vehicle platform is changed. Auto manufacturers spend significant amounts of time and money to change platforms, so once a platform is changed, it tends to stay the same—including the involved components—for several years.

There are around 40 applications of nonwoven usage in a vehicle, not including filtration. Generally, they can be subdivided into two categories:

- visible surface materials (generally needlepunched carpet and trim); and
- nonwovens or nonwoven composites with sound-absorbing and vibration-absorbing functions, along with intermediate and separating layers.

Approximately 30 square meters (sqm) of different nonwovens components are used in the construction of a new light vehicle, depending upon technology and application. This is an increase from an estimated 14 sqm in 2010. The total opportunity for nonwovens in a vehicle could be up to 40 sqm.

Nonwovens can also be classified by their location on a vehicle, the exterior or the interior. **Exterior components** that may include nonwovens are:

- firewall/heat shield insulation;
- firewall/heat shield veil;
- hood liner insulation;
- outer dash panel insulation;
- underbody system/shield;
- wheelhouse liners; and
- other exterior components (e.g., engine encapsulation, adhesive tape cable sheaths, tunnel insulation parts, muffler wraps, battery covers, tarpaulins).

Interior components that may include nonwovens are:

- console components;
- dash package shelf/tray;
- door/kick panels (area under the dash in front of the front doors);
- floor carpeting/mats;
- floor insulation (front and rear);
- headliner (material covering the inside of the roof);
- primary and secondary carpet backing;
- rear package shelf/tray (ledge between the rear seat and the rear windshield);
- seats (notably leather-like microfiber nonwovens);
- seat components (including seatbacks);
- seat trim;
- side pillar trim (vertical or near vertical supports of a vehicle's window area);
- trunk/tailgate liner;
- trunk/tailgate trim; and
- other interior components (e.g., microfiber-based artificial leather, HVAC ducting, console trim, scrims and other interior trim).

Three areas of nonwovens usage within the automotive industry that are currently experiencing a significant amount of activity are discussed below.

An example of nonwovens making inroads is Honda's HR-V compact SUV, which had an acoustic insulation package specially designed for the vehicle. It includes a nonwoven underlay, nonwoven sound-absorbing carpet, nonwoven front and rear inner wheel arches and nonwoven dashboard acoustic pad inserts. The new BMW 7-Series and i3 are made with 14 composite parts using recycled carbon fiber in the form of nonwovens. The parts you can see are in the back structure and in the floor panel. On the i3, the nonwoven roof is made of recycled carbon fiber.

One of the major nonwoven consuming areas of vehicles is the interior floor system. The term vehicle interior floor system is commonly used to describe the integration of style, design, cleanability, durability and acoustics within a vehicle's carpet construction. Since a typical floor system uses an average of 4 square meters (3 to 7 square meters depending on the model segment) of various materials, the use of nonwovens is a critical component in providing increased driver comfort, as well as improved acoustics.

Every vehicle has a floor that needs to be covered, and nonwovens have been used for that purpose one way or another. The materials used in automotive interior carpets include tufted and needlepunched nonwovens. Nonwovens are used as first and secondary backings mainly for making molded carpets. The nonwoven backing for tufted carpets enables them to be easily and accurately fitted, and ensures they remain dimensionally stable even through substantial changes in climate. Tufted materials have lost market share because many tufted carpets are two-layered structures, whereas needlepunch carpet has taken share due to its lower weight and cost. Generally speaking, the tufted carpets are used in more expensive luxury cars while needlepunched nonwovens are used in intermediate or lower grade cars. Nonwovens are also used for floor insulation and mats.

Another type of nonwoven consumption that is easily overlooked is that of cable sheathing. Nonwoven adhesive tapes are used for sheathing cable harnesses. The adhesive tapes bundle the cables and muffle clattering noises. Today, a modern middle-class car comes with about 2,000 meters of cables installed. About 50m of adhesive tape, approximately 20mm wide, are required for manufacturing a corresponding cable harness.

One of the key areas of development for nonwovens in all types of vehicles is in the area of noise, vibration, and harshness (NVH) materials. Extensive research has been carried out in association with vibration, sound, and harshness. Automotive NVH control refers to modification of noise, vibration, and harshness that are associated with the working of the engine, driveline, tires, wind, HVAC system, and other noise producing components in automobiles. While, noise and vibration can be measured, harshness is a term that is perceived as a result, reflecting human subjective impressions.

Automotive NVH control employs materials that reduce the level of disturbing noises and vibrations by either absorbing the sounds or offering insulation for them. Furthermore, vehicle manufacturers are significantly increasing the consumption of these materials to provide a high level of customer satisfaction and a comfortable ride to the occupants. The ability of nonwovens to offer voluminous and soft materials that can handle a number of raw materials and fit nearly any shape continue to win them a role as NVH materials. This will be an issue going forward as from 2024, newly registered vehicles in the European Union will be allowed to generate a maximum of 68 decibels of external noise, a challenge for manufacturers and suppliers alike in light of the current threshold of 72 decibels in already highly acoustically optimized cars.

One area of development that has increased in its usage outside of Europe—where it is more prevalent—is underbody shields and/or systems. They are up to 50% lighter compared with corresponding components made of plastic. The underbody systems also absorb noise and in doing so reduce vehicle noise by up to two decibels. Furthermore, underbody systems enhance the aerodynamics of vehicles by reducing their drag by up to eight percent. This reduces fuel consumption and accordingly also carbon dioxide emissions. Underbody shields are also a sizeable market, as they are on average six square meters of material.

Additionally, in the future nonwovens may be viewed as a key material in electric vehicle platforms as part of the cradle-to-grave design. Electrification of vehicles and ongoing weight reduction are creating radically new NVH profiles which need to be tackled from the ground up rather than relying on the approaches developed for combustion engine-powered vehicles and conventional layouts.

Region View

North America experienced rapid growth in nonwovens production for vehicle construction, increasing 15.2% annually from 2010 through 2020, as not only were more vehicles being produced, but each vehicle had a greater amount of nonwovens. In addition a significant portion of vehicles are exported out of North America. For example, the BMW Manufacturing in Spartanburg, S.C., on average exports 70% of their vehicles produced (218,820 vehicles with an export value of more than $9.8 billion in 2020).

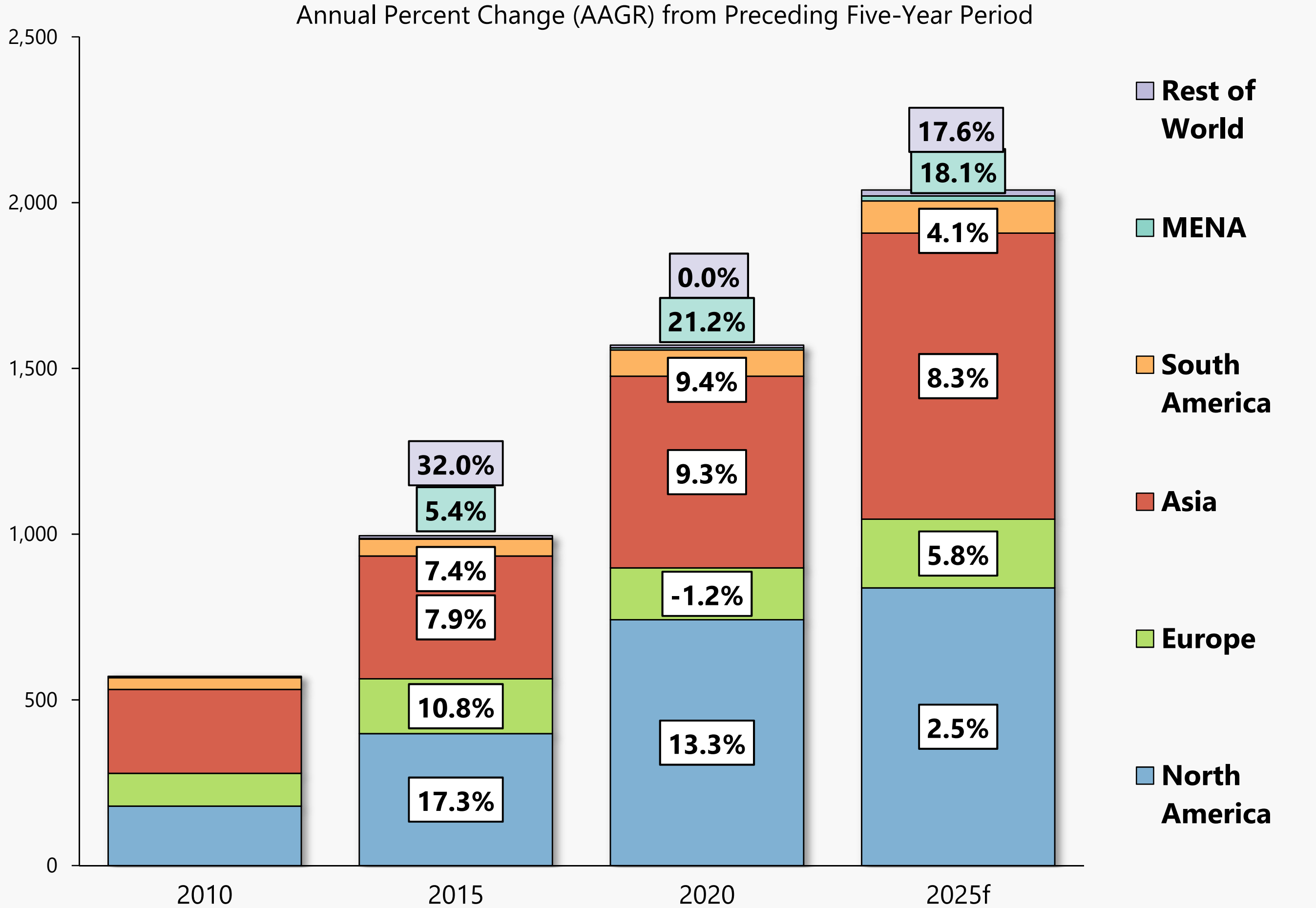
Through the forecast period annual growth rates will slow as not only will vehicle production and sales slow, but with a larger numeric base, it is difficult to maintain the same high growth rates. However, average annual growth rates remain solid in Asia (8.3%, utilizing an additional 284,700 tonnes) and North America (2.5%, 96,100 tonnes). While the Middle East and Africa (MENA) and Rest of the World regions are forecast to experience significant growth rates, combined they only add an additional 18,500 tonnes (Figure III-14).

Figure III-14

Transportation Nonwovens Production by Region

(Thousand Tonnes)

Annual Percent Change (AAGR) from Preceding Five-Year Period



Source: INDA/EDANA/ANFA estimates, 2021

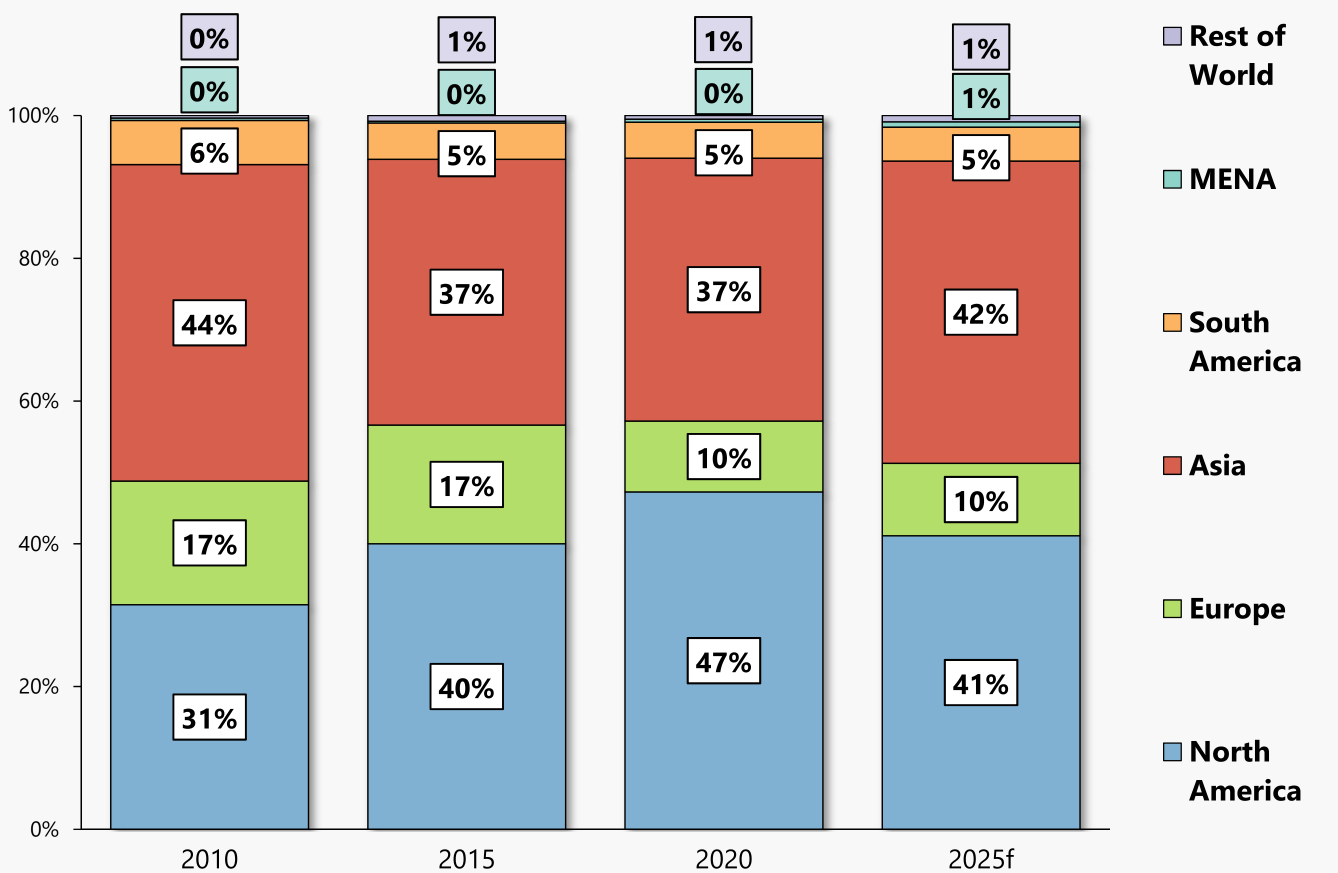
From 2010 to 2020, North America's share increased from 31% to 47%. This is not only a result of a greater amount of nonwovens used in a vehicle, but more vehicles are being sold in North America, and a greater percentage of those sold are produced in North America, many on new production lines. Through the forecast period North America does lose some share to Asia falling from 47% to 41%, as Asia rises from 37% to 42% (Figure III-15).

However, growth will remain strong in North America as automakers' aggressive product launch cadence over the next few years, normally a sign of a strong industry, could be a detriment in the near term as the coronavirus pandemic hampers demand. Automakers are expected to launch 246 new or significantly updated models in the 2020-2023 model years, an average of 62 per year—twice the average number of new or major updated models introduced in the 2004-2019 model years.

Figure III-15

Transportation Nonwovens Production Share by Region

(Tonnes)



Source: INDA/EDANA/ANFA estimates, 2021

According to the Organisation Internationale des Constructeurs d'Automobiles, global vehicle (light vehicles and commercial vehicles) production totaled 77.622 million in 2020, dropping 15.8% below 2019's 92.176 million tonnes. Asia/Pacific accounted for more than half (57%) of the world's vehicle production in 2020, followed by Greater Europe (including both Turkey and the CIS countries) at 22%, North America at 17% and South America at 3%.

Global vehicle production peaked at 97.302 million in 2017. Production declined slightly in 2018 and 2019, though due to COVID-19, much of world's automotive production was shut down for parts of 2020.

At the time of this writing, as we approach the end of 2021, the impact of the semiconductor shortage on the auto industry has yet to peak, contrary to initial expectations of this happening by the end of the second quarter. Not only has the impact intensified in August and September, but the hope of a return to pre-pandemic conditions and a full recovery in early 2022 has all but evaporated. Given the extreme volatility of the situation, global light vehicle production in 2021 is predicted to be only marginally better than 2020. Consultancy AlixPartners estimates the global semiconductor shortage will result in a production loss of 7.7 million vehicles in 2021.

LMC Automotive's global light vehicle production forecast is 80 million units in 2021, 85 million in 2022, and 94 million in 2023, noting that the industry continues to experience volatility from production downtime due to shortages of chips and other parts.

Building Construction

INDA and EDANA include the roofing and house wrap markets—which others sometimes report independently—in the Building Construction category. While these two are the largest segments, there have been significant advancement and innovation of nonwovens in other building construction materials. This report, therefore, takes into account other building construction materials as well. This other category includes building construction materials—primarily glass-fiber nonwovens and polyester nonwovens—used in the areas of ceilings, gypsum wall board, insulation facers, insulation panels/boards, and wall coverings. This broad Building Construction category, based on the location, allows for new nonwoven uses and applications to be included in the building construction area, as opposed to adding to the other category.

Nonwoven production for building construction end uses is the seventh largest of the ten nonwoven end-use categories, comprising eight percent of the global production in 2020 and is the second largest of the durable end-use markets. The building construction share declined slightly through the historical period (2010–2020), dropping a percentage point and is expected remain at eight percent through the forecast period (2021–2025) (Table III-1 and Figure III-2).

The building construction market, not surprisingly, is **primarily driven by building construction**, which is related to the strength of the economy. Building construction is not just residential buildings (single-family and multi-family), but also private nonresidential construction, such as commercial, office, manufacturing, health care and lodging facilities, in addition to public nonresidential construction, such as educational, health care and office facilities.

The **main drivers** of building construction product demand include

- the economy… new residential housing starts, including multi-family starts, nonresidential construction, and repair and remodel spending; and
- global trend towards urbanization, as emerging and developing countries adopt building construction practices from the developed countries

Secondary drivers include

- replacement of traditional building materials (taking share from other materials);
- government spending (public nonresidential construction);
- government regulation (with regard to energy codes); and
- product innovation.

Growth in the amount of nonwoven material used in building construction is driven not only by the amount of construction, but also through substitution and share growth in shingles, wallboard, and ceiling tiles, and the increasing orientation of the construction industry on topics such as heat preservation, energy consumption, and sound insulation, including the corresponding legal guidelines and energy codes. Even in thin layers, polyester nonwovens, for example, protect—as in the case of functional textiles—against overcooling and absorb extraordinarily little moisture.

Nonwovens have also been increasingly used in the building construction industry; for example, glass fiber nonwovens have been increasingly used in flame-retardant applications where they offer superior performance compared to traditional materials. With increasing CO2 regulations and building regulation codes, nonwovens are able to provide cost-effective, environmentally friendly and efficient solutions to various challenges in the marketplace.

In 2020, tonnage consumed by the nonwoven building construction products increased 4.0% annually from 2010 to a level of 1.351 million tonnes. The category will again experience similar growth through the forecast period, rising 3.2% annually, adding an additional 227,000 tonnes (45,400 tonnes annually) to reach a market size of 1.578 million tonnes at the end of 2025 (Table III-7, Figure III-3 and Figure III-5).

Table III-7

Building Construction Nonwovens Production by Region

(Thousand Tonnes)

Region	2010	2020	2025f	Growth (AAGR) 2010-2020	Growth (AAGR) 2021-2025
North America	431	620	671	3.7%	1.6%
Greater Europe	260	289	327	1.1%	2.5%
Asia	207	427	551	7.5%	5.2%
South America	9	14	16	4.6%	3.0%
MENA	4	1	13	-10.5%	58.9%
Rest of World	0	0	0	n/a	n/a
Total	**910**	**1,351**	**1,578**	**4.0%**	**3.2%**

Source: INDA/EDANA/ANFA, 2021

The last Worldwide Outlook for the Nonwovens Industry forecast building construction to expand 5.0% annually through the forecast period (2018–2023). This forecast was not far off of the actual average annual growth rate of 3.9% from 2015–2020.

Glass wool, commonly termed fiberglass, has not traditionally been considered a nonwoven, even though it is similar to a spunlaid process. For the purposes of this report, it is therefore not included. However, wetlaid and drylaid glass fibers are included, as they are used in a variety of building construction end uses. Glass nonwoven materials are used extensively in the construction industry as a reinforcement component in commercial and residential roofing systems, as well as a facer component in roof, deck and exterior sheathing panels. Glass-based nonwovens, also known as veil or matt glass, offer dimensional stability and tear strength. An important attribute for the building construction industry is that glass fibers do not absorb moisture or support mold and mildew growth.

Nonwovens play a significant role in residential and nonresidential buildings, specifically for the "**building envelope**." The building envelope, which consists of roofs, walls, windows, and basements is designed to separate the controlled indoor environment from the outdoor environment. During the past two decades the nonwovens for the building envelope have undergone several advancements in material technology and application processes, most significantly involving roofs and walls.

As growth in housing and commercial markets continues, nonwovens will benefit by supplying both roofing and specialty materials that are engineered to provide the most cost-effective solutions. Known for their durability and versatility, nonwovens deliver cost-effective and efficient solutions. From roof underlayments to building wrap and flashing materials, nonwovens' role in construction is more often than not one of protector, keeping water out and heat and air conditioning in. The materials help reduce air infiltration, which results in increased energy efficiency and optimal moisture control.

Nonwovens will continue to take share from other materials due to nonwovens being better performing, easier to install, and composed of safer materials; having "greener" properties; and being able to meet consumers' desire for a comfortable and efficient space. Nonwovens have also been increasingly used in the building construction industry; for example, glass fiber nonwovens have been increasingly used in flame-retardant applications where they offer superior performance compared to traditional materials.

In building construction, the primary areas in which nonwovens are used are roofing and underlayment.

Roofing

The roofing segment is composed of two markets: residential houses, and nonresidential buildings and apartment/condo buildings. Residential houses tend to vary from flat to steep-slope roofs (greater than 14 degrees) with shingles and metal as the roofing materials. Nonresidential buildings (e.g., commercial, educational, office), and apartment/condo buildings, tend to have low-slope or flat roofs, with their own set of roofing materials.

Demand for products in the **residential** roofing segment is generally driven by both residential repair and remodeling activity, and by new residential construction. However, roofing damage from major storms can significantly increase demand in this segment. Two-thirds to three-quarters of all roofing projects are residential repair and remodel.

The majority of residential roofs are steep-slope roofs. Steep-slope roofs are most often specified for use on residences, as their steep angle minimizes the incidence of leaks. The materials used in steep-slope roofing are asphalt shingles, wood shingles and shakes, ceramic tiles, and metal sheeting.

Asphalt, or bitumen, roofing shingles are the principal roofing products used on steep-slope structures in North America, though metal has been making inroads. In the United States, four out of five homes are covered with asphalt shingles. Asphalt singles are less expensive than ceramic tiles and wood shingles. Asphalt shingles also have lower installation costs due to the very streamlined and rapid process of application and subsequent removal.

Asphalt shingles are made by applying bitumen to a paper, synthetic nonwoven or glass-fiber nonwoven mat. The majority of shingles now have a wetlaid glass-fiber core, due to its superior performance over paper and lower cost than synthetic nonwovens. Glass-fiber-based nonwovens give the shingles better dimensional stability and increased tear strength. In the long term, the increased use of these shingles will constrain replacement demand, as these products can have a lifespan of more than twice that of conventional asphalt shingles. There is a small percentage of asphalt shingles with a spunbond polyester core. These shingles tend to be more flexible, which is important in some of the areas where there is extreme variability in temperatures.

Nonresidential buildings, on the other hand, have a wider choice of roofing materials, with no one material having a dominant share, as in residential. In the past, the only choice for covering flat roofs was asphalt and gravel. Today, however, there are numerous choices to cover a flat roof. These include asphalt and gravel, liquid-applied elastomeric materials, rolled membranes, metal, and "green" roofs. In developed countries, plastic roofing is now the leading nonresidential roofing material installed. Demand for plastic roofing has risen sharply over the past decade, spurred by rising consumer interest in self-adhesive TPO membranes that reduce the time and cost of roof installation jobs. Additionally, rising interest in improving energy efficiency will encourage building owners and managers to install cool roofing materials—such as white or light colored TPO or PVC membranes—that deflect sunlight and minimize the heat transfer from the roof to a building's interior.

Membrane roofing is typically applied by large rolled sheets and is generally fused in some way at the joints to form a continuous surface. There are three basic types of roofing membranes: thermoset membranes (such as synthetic rubber roofs; e.g., EPDM), thermoplastic membranes, and modified bitumen membranes. Thermoplastic (e.g., PVC, TPO, CSPE) sheets are welded together with hot air, creating one continuous sheet. Nonwovens are sometimes used in membrane roofing to serve as a barrier between the deck and the membrane. Additionally, the nonwoven gives tensile strength and elongation to the membrane.

Nonwovens are used primarily as a reinforcement material in modified bitumen (asphalt mixed with polymers such as APP or SBS membranes), though they are also used in a few thermoplastic geomembrane roofing systems and built-up roofing (BUR) as well.

Modified bitumen roofing material—estimated to be used in 20% of low-slope roofing projects in developed countries—is a sandwich of two layers of bitumen with the nonwoven in the center. The nonwoven's function is to act as a carrier and hold the bitumen layers together. Needlepunched polyester and spunbond polyester nonwovens are used, as well as wetlaid glass. Although glass-based nonwovens are less expensive than synthetic nonwovens, modified bitumen roofing material using synthetic nonwovens has the advantage of suppleness and the ability to expand and contract with heat and cold, which may lead to fewer leaks as the roof ages.

Built-up roofing membranes (BUR) have been the traditional low-slope roofing material, used for more than 100 years. It is composed of several layers of bitumen surfaces, finished with an aggregate layer or a coating. Some BUR applications incorporate layers of fabric (typically roof felt or glass-based nonwoven, though some spunbond and needlepunch nonwovens are used as well) added between the layers of bitumen. BUR usage is dropping as the other roofing materials improve in quality and become more cost competitive. In developed countries, it is estimated that the share of BUR roofing in nonresidential roofing applications has dropped to around 10%.

Modified bitumen roofing materials, which have seen their share of nonresidential roofing market drop in the face of strong competition from single-ply roofing, will continue to experience a declining share through the forecast period. Declines in the number of BUR systems installed on newly erected buildings will also affect demand. The reroof segment will continue to support bituminous roofing demand, as there is a large stock of structures with installed BUR systems.

The increase in urbanization in emerging and developing countries will lead to a rise in demand for commercial buildings and industrial warehouses which will propel the flat roofing market in those regions.

Underlayment

Another part of the building envelope is underlayment used on exterior walls, floors, and the roof, prior to the roofing materials. It is also known as house wrap, with the well-known brand names of Tyvek® and Typar®. Even though it is called house wrap, a significant amount of underlayment material is used in multi-unit and nonresidential construction.

The **unerlayment** is a breathable barrier, installed between the wall and exterior cladding of a building, which protects the structure from the elements. Underlayment is impermeable to liquid; allows moisture release to prevent mold, decay, and insect damage; and is an air barrier to provide temperature and energy management.

In developed countries, prior to installing the exterior cladding in a home, a weather barrier is applied. Up until the late 1960s, this meant the use of Grade D Kraft-based paper and/or No. 15 felt, generally referred to as tar paper. These materials were inexpensive and had some positive points, but both were relatively weak and would lose strength or rot when wet. Nonwoven and film materials then entered the market and soon began rapidly taking share. Tests showed that a home with properly installed house wrap will reduce air infiltration by up to 40%, directly reducing the cost of heating and air conditioning

The major material classes of house wrap are: the traditional asphalt-impregnated paper or fiberglass, micro-perforated woven raffia, and four types of nonwoven materials. The nonwoven materials include flat calendered spunbond, extruded coated spunbond, extruded coated spunbond and film composite, and a laminated spunbond and microporous film composite. The nonwoven materials—unlike the other materials—are resistant to tears, abrasion, and punctures. The nonwoven materials can be engineered to be UV stable and/or with a non-slip surface. The nonwoven materials will continue to take share away from the traditional felt, as nonwoven underlayment is preferred for its favorable performance attributes in making a structure more air tight, in addition to being resistance to tears. Furthermore, many nonwoven roofing underlayments have peel-and-stick backings and slip-resistant surfaces that reduce the time and expense of installation.

Roof underlayment installed to the roof construction material prior to the roofing material is similar to house wrap, with the material being engineered with varying degrees of breathability (vapor transmission properties). There are a range of roof underlayment materials, from waterproof single-ply membranes for flat roofs to vapor permeable roof membranes, to breathable membranes and vapor barriers for pitched roofs. Roof underlayment can be a polyester nonwoven, a polyester nonwoven laminated with a heat-reflecting shield, a two-layer polypropylene nonwoven with a micro-perforated polyethylene membrane set in between, or a waterproof membrane set between two layers of polypropylene nonwoven.

New growth areas include **underlayment for flooring**, such as a polyester nonwoven coated with a synthetic film for reducing footstep noise, and subterranean house wraps and film laminates.

Demand for underlayment is tied to new construction, both residential and nonresidential, as little of the demand is from repair and remodel. But like roofing materials, much of the demand for roof underlayment is from the repair and remodel expenditures. Rising residential building construction activity will continue to spur demand, especially as emerging and developing countries adopt current building construction practices.

Other Building Construction Materials

The other building construction materials segment includes nonwovens used for insulation boards/panels and as a facing material for building construction materials.

Nonwoven panels and panel facings are used for the thermal and acoustical insulation of floors, walls, ceilings, attics, and roofs. These thermal-bonded polyester insulation materials are gaining popularity because, in addition to their basic acoustic and thermal features showing outstanding stable performance characteristics throughout their lifecycle, they have features that are environmentally friendly. They often are made from recycled materials and can be recycled themselves. Strong growth is forecast for these panels as consumer interest in reducing energy consumption and utility bills soars. Regulation and adoption of energy codes will also drive their use.

Glass-fiber nonwovens are used as “facers” for acoustical ceiling tiles/panels, HVAC duct systems, gypsum wall board, insulation board facers, fireboard, and interior/exterior wall coverings. The glass-fiber nonwovens offer thermal protection, sound absorption properties and—being glass—offer fire and mildew resistance. The glass-fiber facing adds improved surface protection, print and coating ability, abrasion resistance, and surface integrity.

These glass-facing nonwovens have enjoyed strong growth, taking share from other materials, and this trend is predicted to continue through the forecast period. One area of strong growth has been in replacing paper in specialty gypsum and building boards for exterior sheathing, roof applications, shaft liners and interior building applications. These panels are highly resistant to mold, humidity, and fire.

Another building construction material is architectural membranes, products that carry their load as tension in their plane and add an aesthetic look along with ample amount of light transmission. Architectural membranes are primarily woven or coated fabrics, though nonwovens are used. Architectural membranes are a trending product in the construction industry. Continuous innovations are taking place in the material used as well as polymer materials that are primarily used in the manufacture of architectural membranes. Architectural membranes are most often used in outdoor roofs and shading applications. Features such as lightness, translucency, water tightness, flexibility, easy construction as well as technological advancements lead to adoption of architectural membranes in various construction activities.

Region View

In 2020, North America was the largest building construction region at over half-a-million tonnes (620,000 tonnes), mainly as the majority of residential housing roofs are steep slope roofs using bitumen roofing shingles which include the relatively heavier-weight glass. Nonwoven building construction was relatively subdued in North America and Greater Europe in the last ten years (2010–2020) with average annual growth rates of 3.7% and 1.1%, respectively, adding 189,200 tonnes and 29,000 tonnes of incremental growth, respectively. Asia, starting from a lower base, added 220,200 tonnes of incremental growth, increasing at an average annual growth rate of 7.5% (Figure III-16).

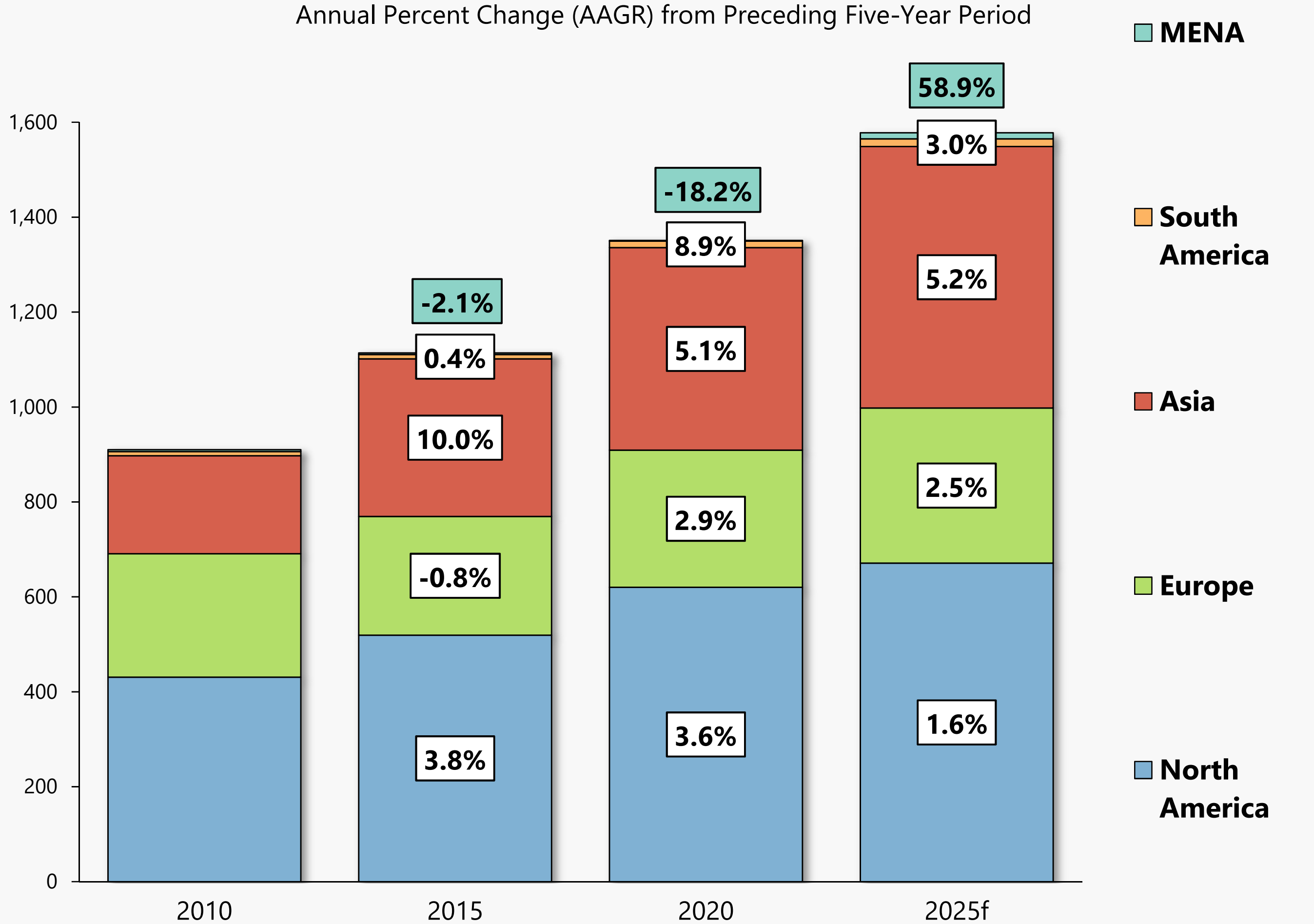
Each region is forecast to experience similar steady growth rates–however North America slows and Greater Europe increases—through the forecast period with Asia adding another 124,300 tonnes of nonwoven production for building construction products, North America another 50,900, Europe 38,000, and MENA 11,700 tonnes (Figure III-16).

Figure III-16

Building Construction Nonwovens Production by Region

(Thousand Tonnes)

Annual Percent Change (AAGR) from Preceding Five-Year Period



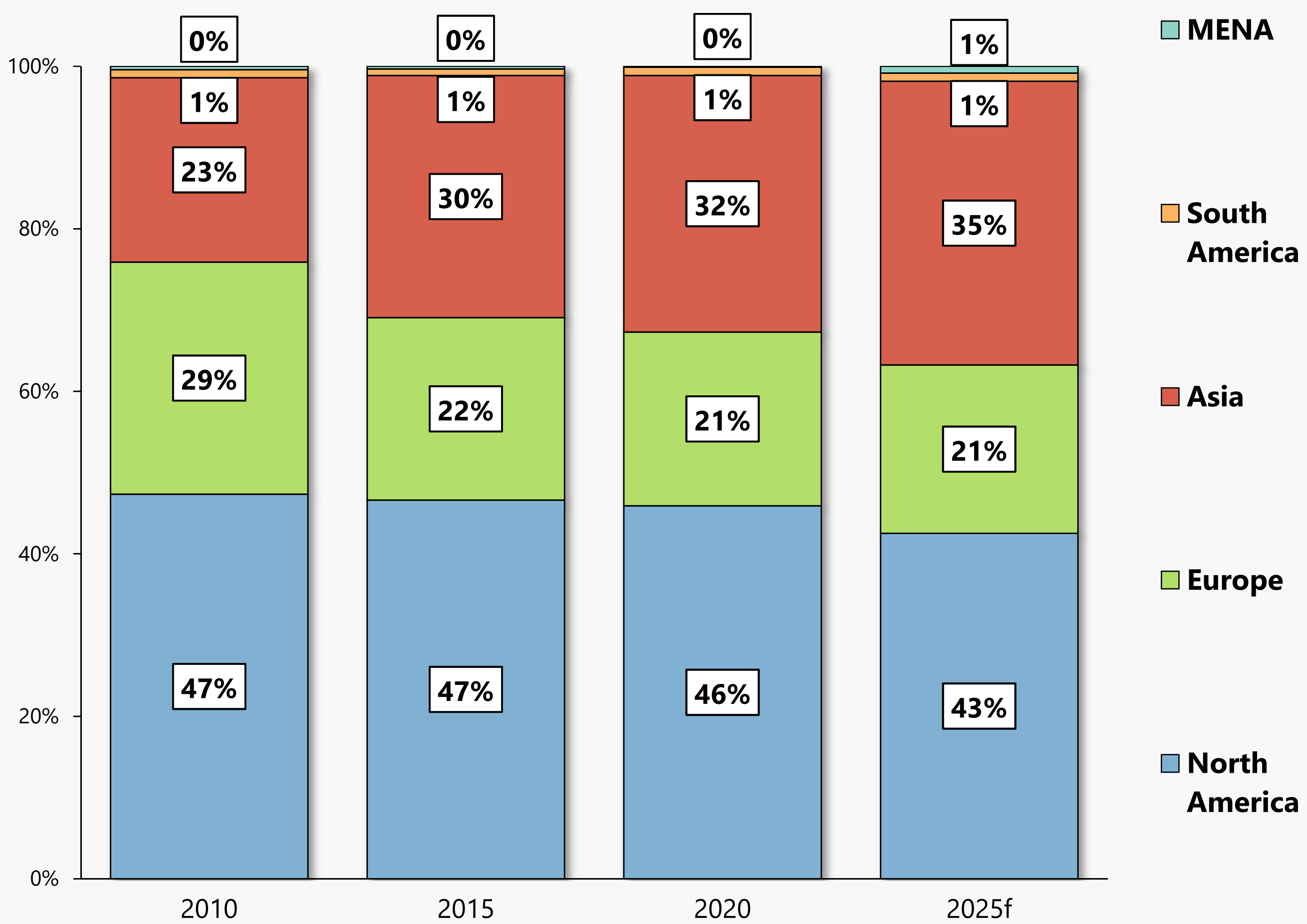
Source: INDA/EDANA/ANFA estimates, 2021

In 2010, North America was the dominant building construction market accounting for nearly half (47%) of the nonwoven production for building construction. Given the slow-growth of the North American housing market through parts of the historical period and Asia's more rapid growth, that share dropped to 46% by 2020. At the same time Asia's increased from 23% to 32%, as Greater Europe's dropped from 29% in 2010 to 21% in 2020. Through the forecast period, Asia will capture an increasing share, rising to 35%, while North America still remains the largest market with 43% share of production (Figure III-17).

Figure III-17

Building Construction Nonwovens Production Share by Region

(Tonnes)



Source: INDA/EDANA/ANFA estimates, 2021

Home & Office Furnishings

Home and office furnishings is another category, similar to building construction, in which durable nonwoven products are classified according to where the product is, as opposed to what it is. Home and office furnishings includes floor coverings, bedding and upholstered furnishings, which others sometimes report independently. The category also includes other furnishings, such as acoustical applications, appliance acoustical insulation, and ironing board pads. Having the category defined this way allows the category to expand as nonwovens appear in new places in the home and office, without having to put those items in "other" or to create a new category. Automotive floor coverings are included in automotive section within the transportation end-use category.

Nonwovens lie in many hidden areas around the home and office, such as carpet backings, mattress and box spring components, upholstered furniture components and backings, drapery liners and ironing board pads, as well as in more obvious places, including blankets, bedspreads, draperies, mattress covers and pads, wallpaper, pillows, and quilts. Nonwovens can be engineered to provide specific functions such as flame retardancy, absorbency, cushioning, stretch, strength, liquid repellence and so much more, and key players in the market continue to develop new solutions to make homes safer and more comfortable.

The home and office furnishings end use was the largest (in tonnage) of durables nonwoven end-use markets in 2010 at 994,000 tonnes and a global production share of 10%. However, transportation and building construction—both of which tend to include heavier-weight nonwovens—passed home and office furnishings, which is now the third largest durable category and eighth overall with a global production share of 6% in 2020 (Table III-1 and Figure III-2).

The developed markets are the primary consumers of the home and office furnishings produced from nonwovens. Many of these items are discretionary items—for example, a mattress and box spring compared to bed roll—that require a significant amount of disposable income. Therefore, the home and office furnishings market is **primarily driven by new and existing home sales**; that is, when a house is sold, the new tenants may add new floor coverings, purchase new mattresses and bedding material or window coverings. However, rising expenditures on housing in emerging economies will drive demand as well.

Business spending and the **home improvement market** also drive demand. All three are related to the strength of the economy; as the economy turns down, so does the purchase of homes, consumer spending and business spending.

The **main drivers** of nonwoven home and office furnishings, therefore, include

- the economy… new and existing home sales, business spending and home improvement spending.

Secondary drivers include

- institutional (education, healthcare, government) spending;
- government regulation (with regard to flammability);
- capturing share from other materials; and
- product innovation.

The nonwoven home and office furnishings end use consumed 1.131 million tonnes in 2020, an average annual growth rate of 1.3% from 2010, which was the slowest across the ten end-use markets. By 2025 the end use is forecast to consume an additional 218,000 tonnes (43,500 tonnes annually), reaching 1.349 million tonnes, a 3.6% annual growth rate (Table III-8, Figure III-3 and Figure III-5).

Table III-8

Home & Office Furnishings Nonwovens Production by Region

(Thousand Tonnes)

				Growth (AAGR)	
Region	**2010**	**2020**	**2025f**	**2010-2020**	**2021-2025**
North America	395	459	498	1.5%	1.7%
Greater Europe	271	300	345	1.0%	2.8%
Asia	245	307	414	2.3%	6.2%
South America	62	48	57	-2.4%	3.4%
MENA	22	18	35	-2.0%	14.6%
Rest of World	0	0	0	n/a	n/a
Total	**994**	**1,131**	**1,349**	**1.3%**	**3.6%**

Source: INDA/EDANA/ANFA, 2021

The home and office furnishings forecast from the last Worldwide Outlook for the Nonwovens Industry was on the hopeful side, with a 3.9% annual increase through the forecast period (2018–2023). This forecast is more than double that of the longer historical growth of 1.3% annually.

Innovation and new uses will continue in the home and office furnishings market as it continues to successfully employ nonwovens for the array of features and advantages the fabrics can provide such as comfort, uniformity, light weight, durability, flame-resistance and aesthetics. Current development is focused on improving the acoustical characteristics of living and working spaces and in the use of sustainable solutions either through the use of natural fibers and/or post-consumer recycled content. Architects, home furnishing companies and construction companies are being requested by their customers to use components and products with a low environmental footprint. People also want to live and work in healthier indoor environments.

Another driver in the home and office furnishing markets is product flammability regulation. Consumer and commercial upholstered products, whether furniture or mattresses, have flammability regulations that must be adhered to, while commercial products have additional flammability requirements in regard to window treatments. Further, nonresidential wall coverings are being developed that provide flame retardance benefits.

Floor Coverings

The floor covering market comprises three segments: woven and tufted carpet backing; underpads/underlay and floor protectors; and entrance/walk-off mats.

Carpets and rugs can be classified by multiple criteria. A carpet is any textile floor covering that is directly fastened to the floor and usually covers the entire floor area; hence the name ‘‘wall-to-wall’’ carpeting. A rug is not fastened and does not cover the entire floor area. With the growth in popularity of hard surface flooring in recent decades, rugs have enjoyed renewed sales. Rugs are classified as room-size and area types.

Carpet and rugs are also classified by production process: tufted, woven, and other. Modern tufting and woven carpet manufacturing employs advanced technology to provide capability for a myriad of patterns and floor coverings. The dominant carpet and rug type is tufted, in which manufactured fibers (tufts) are imbedded in a primary backing. The primary backing can be woven or nonwoven, though a nonwoven helps to stabilize the tufts for long-term use of the carpeting. A typical tufting machine consists of several hundred needles that stitch hundreds of rows of pile yarn tufts through a backing fabric called the primary backing. The needles push the carpet yarn through the primary backing material, where a loop holds the yarn in place to form a tuft as the needle is removed. The yarn is then caught by loopers and held in place for loop pile carpet or cut by blades for cut pile carpet. Secondary backings of various types, including nonwovens, are applied to render a variety of performance properties. The nonwoven backings, in addition to dimensional stability, can add strength, thermal stability, and cushioning.

The term broadloom refers to carpet manufactured in long rolls of 150–300 feet. This production process is highly automated, faster, and requires less dependence on skill on the part of labor. Due to its lowered cost of production and its acceptability by consumers, this process has proliferated since its introduction and dominates the market. Although the tufting process is used for some scatter rugs and bathmats, broadloom carpeting (over 54 inches in width with 12-foot widths most common) is by far the most common tufted type. This carpeting type is used extensively in residential, commercial, and institutional applications.

Broadloom was the dominant commercial carpeting choice a decade ago, until tufted **carpet tiles** began to replace broadloom carpets in corporate offices and some institutional sectors. Tufted carpet squares have further expanded into other commercial buildings (retail) and institutional (educational, health care and government) facilities. Tufted carpet squares, also known as carpet tiles, carpet squares, or modular carpet, have been gaining share as a result of their durability together with ease and flexibility of design, installation, storage, maintenance, and replacement. It's much easier to store and replace squares of carpet than large rolls. Tufted carpet tiles are increasingly being recognized by those responsible for specifying materials for government and institutional projects in regard to its end-of-life options.

Nonwovens are the predominant backing for tufted carpet tiles. The nonwoven backing, in addition to dimensional stability, can add strength, thermal stability, and cushioning. Woven is the predominant backing for broadloom carpeting, due to its lower cost and adequate performance. Nonwoven backings are used in patterned broadloom carpeting installations. These multicolored patterned carpets are typically found in hotels or commercial office entryways. A standard woven backing will stretch over time, thus distorting the pattern, which is why a nonwoven backing is preferred.

Nonwovens are also used for **underpads and floor protectors** for carpets and rugs, typically when a carpet is replaced.

Floor mats or **walk-off mats**—a carpeted or needlepunched, rubber-backed surface typically situated just outside and/or inside the entrance to a building where there is considerable pedestrian traffic—also use a nonwoven backing. These mats are made for high traffic applications and only have a service life of a few years. Their use is not necessarily tied to new construction but more to the weather and economy. Sales of these mats are sensitive to commercial activity, as replacing older mats with new products is one of those improvements that can be delayed in poor economic times. The majority of these mat sales are to replace existing mats, as opposed to the installation of a mat at a new building or in a new location.

Bedding

In mattresses and bedding, nonwovens are used as fillings for quilted mattress covers, mattress protectors and upholstered mattress covers, as well as fillings for bedspreads and quilts. The nonwoven is used to wrap the springs to protect other materials from sharp edges. Nonwovens are also used to clad the backs, inserts or undersides of beds that are not visible to the eye. It is also used to protect against dust and to dampen sound to create a more luxurious bed experience. In waterbeds, special nonwovens are applied to control the movement of the water filling, making these beds even more comfortable. Materials for mattresses and bedding provide for optimum temperature regulation, allowing the skin to breathe and thus helping to regulate moisture levels during sleep. Nonwovens combine optimum bulk with a high recovery rate, thus helping to prevent the formation of dents and creases. Nonwovens are used as quilt backing to give "puff" to mattresses and/or foundation units.

Nonwoven blankets, including both moving blankets and emergency/relief blankets, have been included in the bedding category. This category also includes single-use bedsheets and pillow covers, items which are likely to grow in popularity in the close future in Europe with the revival of sleeping cars on long-distance night trains.

Nonwovens are also used as bedding construction fabrics for mattress quilt backing, flanging, spring insulators, spring wrap, box spring dust covers, and mattress ticking on some lower-priced bedding. Fire barrier products that are used directly underneath the fabric or ticking are also made.

North America is one of the largest mattress-consuming regions in the world, as the United States is the largest mattress-consuming country in the world, while Canada is the fifth largest and Mexico the fourteenth largest.

At a country level, a large share of world mattress consumption (approximately 70%) takes place in five countries only: the United States, China, Brazil, India and Germany.

The top two countries are very close; however, China showed the most impressive increase in terms of mattress consumption over the last few years, and important growth rates were registered also by other Asian countries like India and Vietnam.

A trend impacting nonwovens in the bedding industry is the growing share of non-innerspring mattresses over innerspring mattresses. An innerspring mattress uses a spring assembly as the main support system. A non-innerspring mattress contains no innerspring unit and provides support by means of foam (all types), air, water, and other support systems. A non-innerspring mattress uses less nonwoven than an innerspring mattress.

Upholstered Furniture

Nonwovens are used as construction materials in several areas of upholstered furniture, including spring insulator pads, foundation dust covers, pull strips, pillow or cushion wrap, skirt linings and batting or highloft material. Nonwoven materials already have good penetration in the upholstered furniture market in all applications; accordingly, nonwovens will grow as a result of increasing upholstery volume.

The commercial upholstery market is becoming increasingly performance oriented, with noticeable growth in health care, hospitality and sports. New fabrics and coatings are in demand and in development. When most people think of commercial upholstery, they think of offices. While that`s a big part of the market, it`s by no means where the most growth is taking place. The hot spots are where there`s the biggest economic boom and where the upholstered items must be replaced or refurbished most often. Health care fits both those descriptions. The health care market doesn’t just mean hospitals; it includes quite a range of facilities, such as senior living and nursing homes, which are expanding rapidly. In addition, emergency clinics are spreading all over the place, as are veterinary clinics, physicians’ offices, and MRI facilities.

A trend in the furniture market is reshoring. Companies are expanding local production due to consumer preferences and, in some cases, tariffs. This has been spurred in part by the internet, which has reshaped shoppers’ behavior and expectations. Consumers are demanding an ever-greater array of materials, fabrics, models, variants, and other customization options. Customization is not the only challenge for today’s upholstered furniture manufacturers; consumers don’t have the patience to wait two months for an item to arrive from overseas. E-commerce sales now represent 10 to 15 percent of total upholstered furniture sales and is the fastest growing distribution channel. The Internet has raised consumer expectations on delivery speed; consumers' purchasing decisions are increasingly influenced by how quickly and easily they can receive their goods.

Nonwovens are also being used as an alternative or replacement to foam in indoor and outdoor furniture. Densified fiber nonwovens are in many instances easier and faster to work with than foam. Nonwovens can offer fully recyclable materials that deliver enhanced comfort, pressure relief and breathability for a wide range of cushioning applications. Depending upon the nonwoven, it can weigh only half as much as foam.

Other Furnishings

The other furnishings segment of home and office furnishings includes window treatments (shades, vertical blinds, and drapery buckram), wall coverings/wallpaper, and other nonwoven products. Other items in other furnishings include nonwoven for acoustical applications and appliance acoustical insulation. Ten years ago window treatments were the predominant product within the other furnishings category, but wall coverings/wallpaper is now, by far, the predominant product in other furnishings.

Window treatments, which include vertical blinds and pleated window shades, use spunbond polyester extensively in their construction. Polyester is heat sealable and retains a crimp, properties desirable in making the pleated shades. Pleated window shades reached their peak in the mid 2000's and are now losing share; consumers in developed markets now have a greater variety of products to choose from, with wood shades now preferred by consumers.

Recently, alternative window coverings such as cellular shades, panel tracks, roman shades, and vertical blinds have begun to take share in the developed markets from more traditional drapery styles. Nonwovens are now increasingly being used as window treatments because they are lighter weight and lower cost compared to woven or knit alternatives, are easily pleated, offer variety in fibers and textures, and meet designers' need for novel appearance. They also do not fray like woven fabrics and don't require hot-knife slitting. Further, nonwovens can be used as a sun protectant for window treatments such as curtains, roller blinds and sunshades, as well as awnings, canopies and marquees.

An advantage of nonwovens over other materials used in these applications is that the materials can create beautiful effects based on the diffused natural light performance they deliver. In certain applications, nonwovens are replacing wovens as backing reinforcement in decorative window treatments.

Nonwoven wetlaid wallpaper has been stronger in Europe than North America. In contrast to the U.S. and Canada where drywall construction is more common, much of the construction in Europe involves plaster, where nonwovens' dimensional stability and dry strip-ability are welcome.

Wallpaper was a popular choice in the 1980's, but demand in volume has slid down ever since. But nonwoven wallpaper has increasingly become more popular throughout the developed markets, especially as a replacement for paper- or vinyl-based wallpaper during renovation of existing residential properties. Furthermore, nonwovens are increasingly the product of choice for wallpaper installers and design professionals. It is still estimated that of the wallcoverings market, wallpaper is less than 20%, the other wall coverings being decorative tile, wall panels, and specialty woven wall fabrics/textiles/grasses.

Wallpaper has become a specialty, a luxury item. In combination with the latest digital printing technologies, nonwovens are providing the ideal medium for advanced modern wall coverings. Nonwovens run better than other material during printing, generate little dust, and do not cause many stoppages in production.

Nonwovens are preferred for proving the same aesthetic features and performance qualities of traditional vinyl covering, and nonwovens are entirely PVC free. Their highly breathable surfaces increase resistance to mold and mildew in high-humidity environments. Further, nonwovens can be engineered to offer many benefits for today's wallcoverings, including a uniform structure, tear and puncture resistance, excellent abrasion resistance and flame retardancy. Their ability to readily take and contain ink offers endless possibilities in terms of design by conventional methods, or more recently, digital printing. Nonwovens possess high opacity and a smooth surface, making it an ideal choice for wall decoration projects in environments such as retail, education, leisure and events.

Acoustic nonwovens are continuing to play a bigger role in dampening noise in homes as well. These can be used in a number of applications where acoustics are a prime consideration for either artistic or purely functional reasons. In addition to office buildings, partitions and furniture in offices, they can be found in airports, municipal halls, theaters, convention centers and subway stations. The use of nonwovens in acoustic room elements for offices is a relatively new area of application and new product designs are continuing to emerge.

Region View

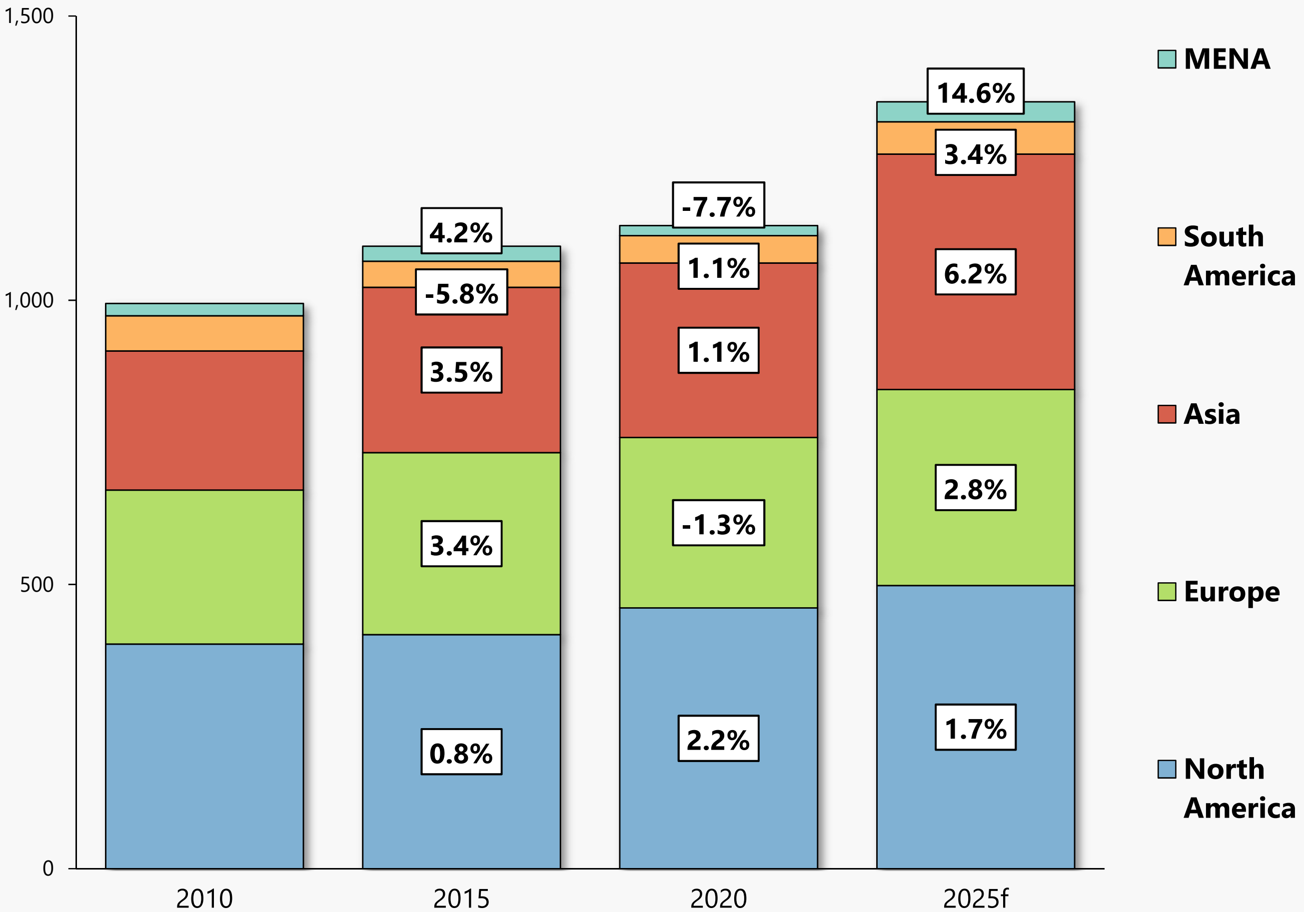
Of the three main regions, Asia leads the regions in average annual growth rate forecast (6.2%) and in incremental tonnage added through the forecast period (107,200 tonnes), followed by Greater Europe (2.8%, 45,000 tonnes) (Figure III-18).

Figure III-18

Home & Office Furnishings Nonwovens Production by Region

(Thousand Tonnes)

Annual Percent Change (AAGR) from Preceding Five-Year Period



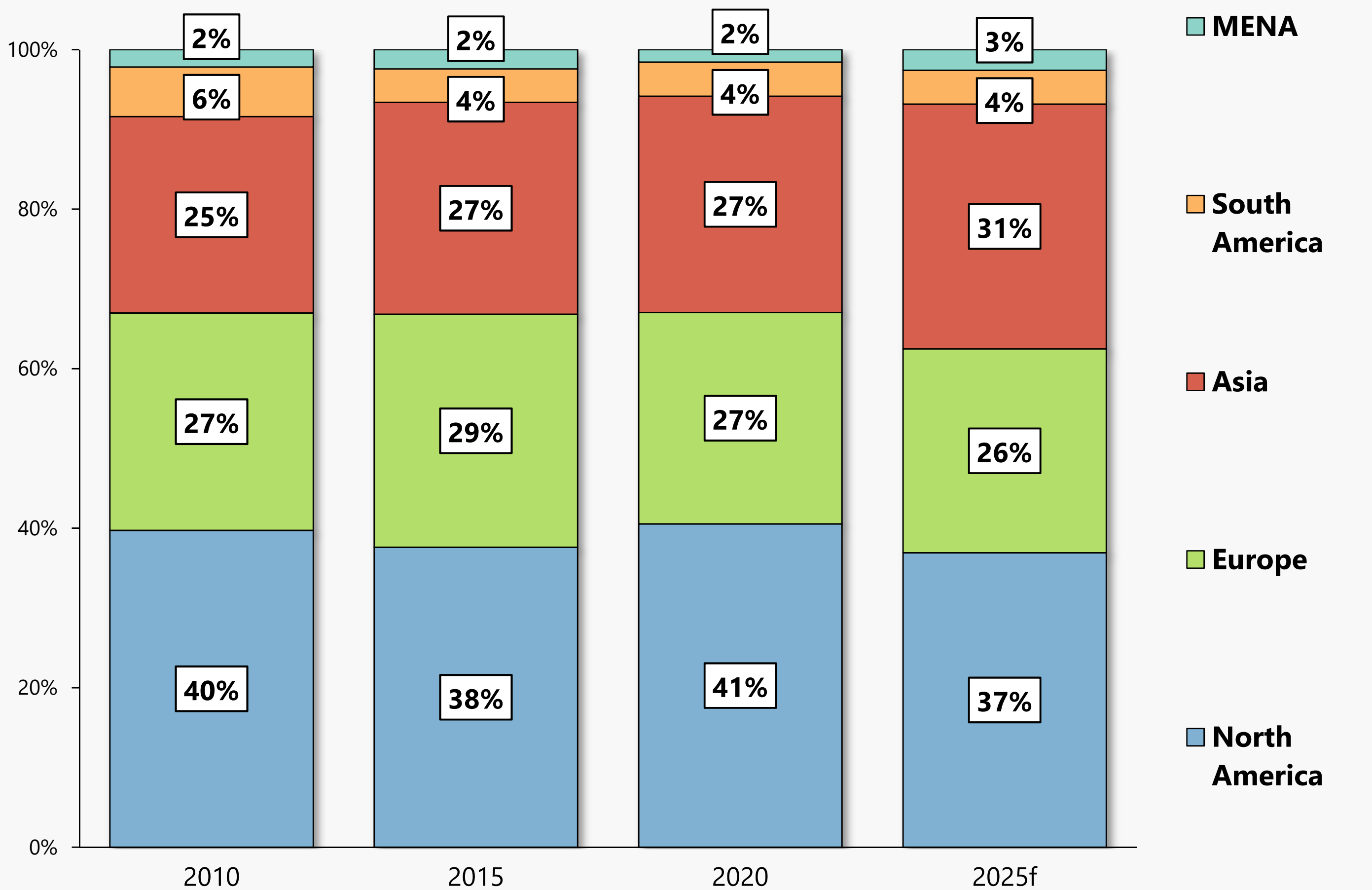
Source: INDA/EDANA/ANFA estimates, 2021

The three main regions—Asia, North America and Greater Europe—accounted for nearly all (94%) of the home and office furnishings nonwovens production in 2020. This is one of the few end-use segments in which Asia does not take significant share through the forecast period, only increasing its global production share four percentage points, from 27% in 2020 to a forecast share of 31% in 2025 (Figure III-19).

Figure III-19

Home & Office Furnishings Nonwovens Production Share by Region

(Tonnes)



Source: INDA/EDANA/ANFA estimates, 2021

Geosynthetics

The geosynthetics category is comprised of two markets: **civil engineering** and **agriculture**. The civil engineering products are primarily those made from geotextiles, while the agriculture products tend to be of a similar nature and nonwoven manufacturing process as geotextiles. Because of their similar nature, they have been combined into one category.

The nonwoven geosynthetics end-use category is the fourth largest (in tonnage) of the durables nonwoven end-use segments and ninth overall, using 6% of the global nonwoven materials in 2020 (1.080 million tonnes), and is forecast, based on a 7.4% average annual average growth rate, to increase its share to 8% (1.541 million tonnes) (Table III-1 and Figure III-2).

The geosynthetics market is **primarily driven by the strength of the economy**, which has the biggest impact relating to the expansion of private infrastructure and buildings, and **the government**, be it through spending on public buildings, infrastructure, legislation or regulation. Further, the global geosynthetics market growth is driven by their increased adoption in a variety of applications in the construction sector, and the emergence of these as viable alternatives in waste and water applications has further bolstered global geosynthetics market growth. Moreover, an increasing number of infrastructure development projects in developing countries—notably China's Belt and Road Initiative—are increasingly specifying the use of geosynthetics in roadways and rail construction applications.

The **main drivers** of geosynthetic product demand include

- the economy… building and road construction, and infrastructure products;
- product adoption; and
- increasing industrialization and urbanization.

Secondary drivers include

- the need for increased production efficiency in agriculture;
- the need to renovate existing roads and structures;
- government spending;
- government legislation;
- government regulation (with regard to waste and chemical containment);

- capture of share from other materials; and
- product innovation.

Further advances will arise from growing concerns regarding environmental protection and greater awareness of the performance advantages of geosynthetics in a wide variety of applications, allowing geosynthetics to gain market share at the expense of other materials.

The high demand for geosynthetics from the construction sector, transport industry (road and railway), and containment sectors (waste management and water management) will boost future growth of nonwovens in the civil engineering markets. Geosynthetics are still underutilized, and there is potential upside and reasonable potential for some areas to have double-digit growth over the next several years.

In 2020, nonwovens produced for the geosynthetics markets reached 1.080 tonnes, an annual increase of 4.8% from 2010. By 2025 the end use will consume an additional 460,000 tonnes (92,000 tonnes annually), reaching 1.541 million tonnes, a 7.4% annual growth rate (Table III-9).

Table III-9

Geosynthetics Nonwovens Production by Region

(Thousand Tonnes)

Region	2010	2020	2025f	Growth (AAGR) 2010-2020	2021-2025
North America	251	190	215	-2.8%	2.5%
Greater Europe	130	155	173	1.8%	2.2%
Asia	232	605	957	10.1%	9.6%
South America	27	62	79	8.9%	4.9%
MENA	26	43	86	5.4%	14.7%
Rest of World	13	25	31	6.8%	4.4%
Total	**678**	**1,080**	**1,541**	**4.8%**	**7.4%**

Source: INDA/EDANA/ANFA, 2021

The forecast from the previous Worldwide Outlook for the Nonwovens Industry was relatively accurate, with the forecast (2018–2023) calling for a 6.6% average growth rate, compared to the previous 10-year average of 4.8% and the last 5-year's annual average of 5.0%.

Civil Engineering

The term "geosynthetics" is used to describe products made from one or more planar polymeric materials used in civil engineering applications in contact with rock, soil, or other geotechnical material such as concrete or asphalt. The problems encountered in civil engineering are diverse, and engineers face a wide range of challenges in solving them; geosynthetics play a role in those solutions.

Many types of civil engineering projects drive the use of nonwoven geosynthetics, such as road pavement reinforcement (asphalt overlays), new road subsoil stabilization, erosion control, pond liners, hazardous waste containment liners, rail construction, and tunnel construction.

Geosynthetics consist of eight main product categories: geotextiles, geomembranes, geocomposites, geosynthetic clay liners (GCLs), geocells, geogrids, geonets, and geofoam. Nonwoven fabrics are used in the segments of geotextiles, geosynthetic clay liner composites, and other geosynthetic composites, specifically cured-in-place pipe (CIPP). Both the geosynthetic clay liner composites and other composites, such as geocomposite drainage systems, use geotextiles in their structures.

Other new applications of geotextiles are in green roof systems, artificial turf fields, colored fabric to improve visible aesthetics, integrated conductive layers, 3-D patterns within the fabric, and the embedding of radio-frequency identification (RFID) tags in asphalt geotextiles to provide information to road maintenance staff and inspectors.

Geotextiles are fabrics that have been designed and manufactured for use in the ground. Geotextiles have been used since the time of Pharaohs of Egypt, mostly to stabilize roads. These early geotextiles were made of natural fibers, fabrics, or vegetation mixed with soil to improve road quality, particularly when roads were made on unstable grounds. Generally, a geotextile fabric performs one or more of the following functions: separation, reinforcement, filtration, drainage, and protection. They are flexible so that the fabric can be fitted to the positions needed (many are curved), and they are porous to allow liquid to flow through the fabric.

In general, geotextiles can be manufactured using three principal technologies: weaving, knitting and nonwoven manufacturing processes. The share of nonwoven usage varies depending upon the end use. Geotextiles used for road protection are about 70% woven fabric, while geotextiles used in GCLs and for geomembrane protection are nearly 80% nonwoven. Nonwoven fabric has a predominant share in road repair, geosynthetic clay liners and geocomposites.

Nonwoven geotextiles are now the preferred material for various application segments of geotextiles as they are capable of withstanding harsh conditions and challenging construction loads. The flexibility and elongation properties and the ability to provide high puncture resistance without sacrificing filtration properties have resulted in a growing demand for nonwoven geotextiles.

The civil engineering category is further segmented into three sub-categories: geotextiles for road applications, geotextiles for other applications and cured-in-place pipe (CIPP). Geotextiles for road applications are typically for highways and streets, while geotextiles for other applications include uses in sewage and waste disposal, water supply (including water treatment plants and reservoirs), power (including buildings and structures for the distribution, transmission, gathering, and storage of natural gas and crude oil) and other transportation (including airport runways and other airport facilities; railroad and other mass transit tracks, bridges, and other transit facilities; docks, piers and other maritime facilities).

Nonwoven geotextiles are manufactured with needlepunch technology or produced in spunbond sheets, with needlepunch being the predominant technology. Both products are usually in a weight range from 135 gsm to 2200 gsm. In general, the spunbond geotextiles are slightly more economical to produce, with manufacturing costs usually around 10% lower than those of comparable geotextiles made from drylaid fibers. The reason for this advantage is the lower cost of raw materials (fibers are more expensive than resin) and the fact that spunbond geotextiles generally have a lower basis weight. Needlepunch nonwoven geotextile fabrics have high permeability as a result of high porosity, and conformability because of their high elongation characteristics. Spunbond nonwoven fabrics typically have high modulus compared to needlepunched fabrics, and high conformability. Generally, woven fabrics exhibit high tensile strength, high modulus, and low elongation. However, neither production method is assigned to any one geotextile task.

Nonwovens' resistance to tears, soil chemicals, puncture, UV light exposure, mildew, rot, and freeze/thaw conditions make them an ideal choice for many applications. Major uses in the nonwovens geotextiles market include separation and stabilization in road and railway construction, asphalt overlay, separation of dissimilar materials, reinforcement and stabilization of soils in erosion control, liner protection and cushioning in containment projects, and filtration of soil to allow the free flow of liquids in drainage applications.

Over the past 40 years, significant advances have occurred in manufacturing, such as in the additive packages on the polymeric side. These advances have greatly expanded the possible strengths and lifetime durability of geotextiles. And manufacturing advances have also contributed to improving the economics of geotextile production, even for the most highly engineered geotextiles.

Geotextiles will **continue to gain market share** at the expense of more traditional building materials such as layers of soil and rock aggregates and poured concrete, as—along with many nonwoven fabrics—they offer better performance at a lower cost. Geotextiles offer a cost advantage, not only because they save materials cost, but also because they tend to be easier to transport and install.

Gains will be driven by an increase in infrastructure spending on bridges and tunnels, a slight increase in public transit and rail construction and stronger growth in both construction activity and airport construction, and a continued increase in activity of the energy markets, especially shale. There are huge energy categories, such as oil, natural gas and coal, but geosynthetics also play a role in nuclear energy, hydropower, wind power and solar power, among others. Geosynthetics line storage tanks, support roads to remote sites, line tailings ponds, provide filtration, dewater coal ash, and line freshwater storage ponds and tanks.

Agriculture

In general, nonwoven agriculture materials are used to control the growing environment, in order to improve the quality of the plantings and to boost crop productivity. In the forms of covers, nets, and mats, they can offer shade and protection (from birds, insects, frosts, winds, and hailstones), and they can suppress the growth of weeds and help the surrounding soil retain groundwater. The global agriculture market can be divided into three segments: agricultural crop covers, landscape fabrics, and root bags.

Agricultural crop covers and shading, also referred to as shade cloth or row covers, are used by farmers, commercial horticulturists (for large commercial lawn landscaping), golf course designers, building contractors, and home gardeners. The fabrics are placed over a crop or lawn in early spring or late fall. They moderate temperature, moisture, gas exchange, and light, and provide an enhanced environment that promotes rapid growth while protecting the crops from pests and weeds. When used as a ground cover, agricultural fabrics are generally employed during the winter months to protect grass or vegetation from snow and ice. The material is also used as a row cover on delicate crops such as strawberries. The crop covers supply sufficient warmth to help seeds germinate, enabling a farmer to get a head start on the season and enter the market weeks before the competition.

Most shade fabrics are woven fabric, to let through some light and water. Nonwoven crop covers are generally made of lightweight spunbond polypropylene material, averaging about 13 to 17 grams per square meter. Spunbond polyester materials are also employed and sold at a premium. Crop cover fabrics must be ultraviolet (UV) stabilized or the materials will lose strength and decay within a year. These materials are generally colored white, but some fabric is also natural, with no added pigments.

In North America, there is a trend towards legalizing the cultivation of hemp and cannabis for medical-use marijuana. Ground covers are increasing sales in the U.S. states where these crops are being grown. The covers assist growth by keeping the ground warm and reflecting additional sunlight into the plants from below. In addition, after the plants are cut, they can be dried on the ground covers.

Another area of growth is roof-top gardening and vertical farming—the use of vertically mounted banks of trays to produce food—to meet the desire for more sustainable, locally sourced food production.

Landscaping nonwoven fabrics are typically used for weed control and colored black or deep brown to blend in with the surrounding topsoil. Like the nonwovens used in crop covers, most are made of spunbond polypropylene with minor amounts of spunbond polyester. Landscape fabrics are much heavier than crop covers, generally found in the 45 to 68 grams per square meter range or higher, depending upon the final use. Unlike films, the fabrics are permeable, allowing rain to penetrate to the soil below.

Root bags are used to wrap and protect the root ball of larger plants and trees for temporary storage and transportation. These bags are typically made of needlepunched materials. The nonwoven can be left in place at planting, since the material is porous and the plant's roots move through the nonwoven as it grows.

Various innovations in the industry, such as induction of advanced materials have opened up potentials for innovation in shading and crop protection, including capillary nonwovens, floating covers, and nonwovens incorporating pesticides, fertilizers, superabsorbent polymers and seeds. These innovations are expected to drive market growth over the next five years.

Region View

In the last decade (2010–2020), the global production growth of nonwoven geosynthetics material was bifurcated with negative growth in North America and slow growth in Greater Europe, as opposed to Asia which grew in double-digits and South America, near double-digit average annual growth rates. Overall, the category grew at an average annual rate of 4.8% from 2010 through 2020. The slow economic growth and lack of infrastructure spending caused the North American market to contract (–2.8% annually) and the Greater European market to register minimal growth (1.8% annually) during 2010–2020. On the other hand, Asia, South America, and the Middle East and North Africa regions underwent significant growth on an average annual rate, expanding 10.1%, 8.9%, and 5.8% respectively (Figure III-20).

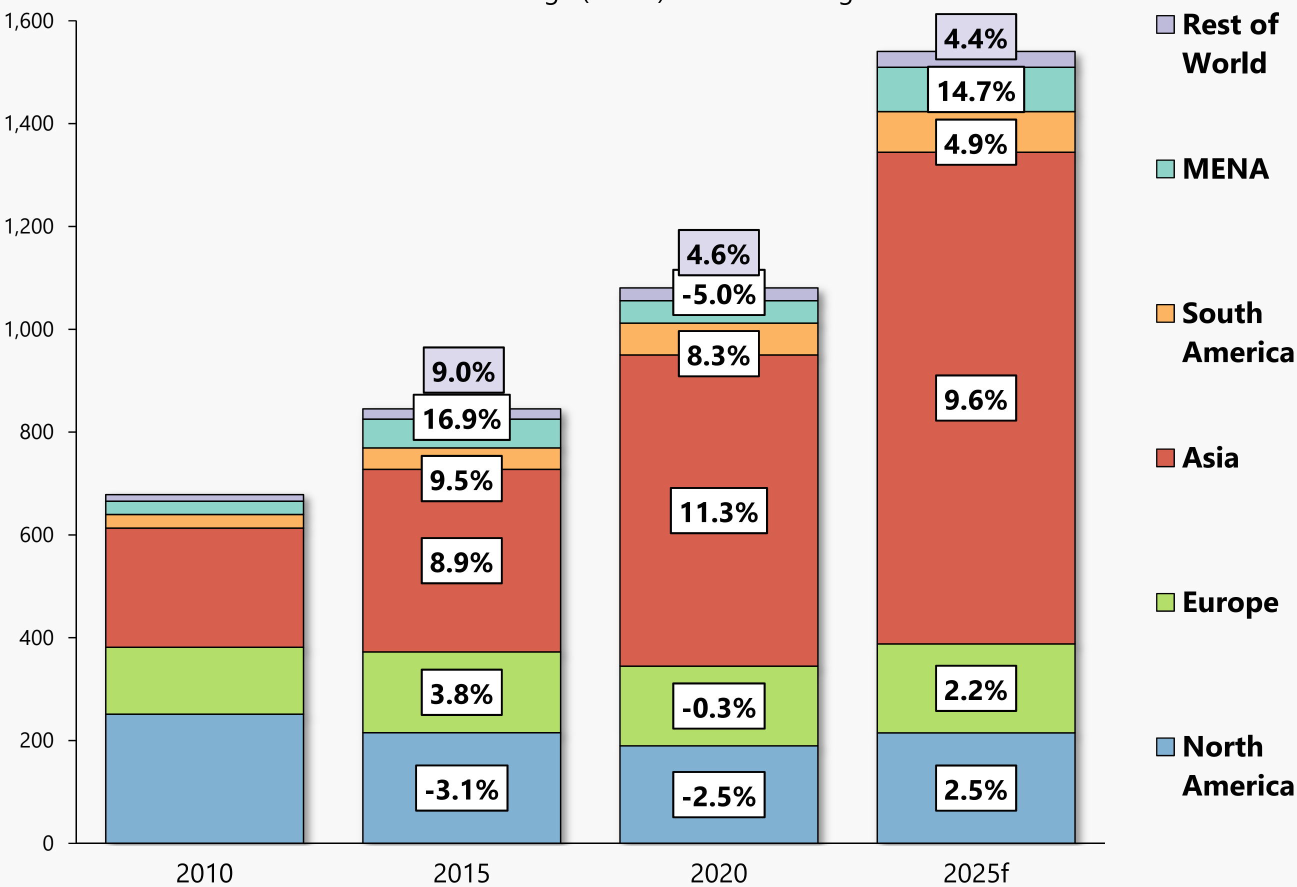
Looking forward, the forecast projects the growth rate to increase (7.4% annually) as increasing investments in infrastructure and environmental projects by developed, emerging, and developing countries are likely to drive the growth of the geosynthetics market, especially countries in Asia, Eastern Europe, Middle East and North Africa, and South America. Asia is expected to lead the growth, producing an additional 351,200 tonnes for the geosynthetics market by 2025, a 9.6% average annual growth rate, which may be conservative depending upon when and to what extent China's Belt and Road Initiative comes to fruition. The North America forecast may be conservative—a 2.5% average annual growth rate, adding an additional 25,400 tonnes—depending upon whether the U.S. government were to initiate the large-scale infrastructure spending package (Figure III-20).

Figure III-20

Geosynthetics Nonwovens Production by Region

(Thousand Tonnes)

Annual Percent Change (AAGR) from Preceding Five-Year Period



Source: INDA/EDANA/ANFA estimates, 2021

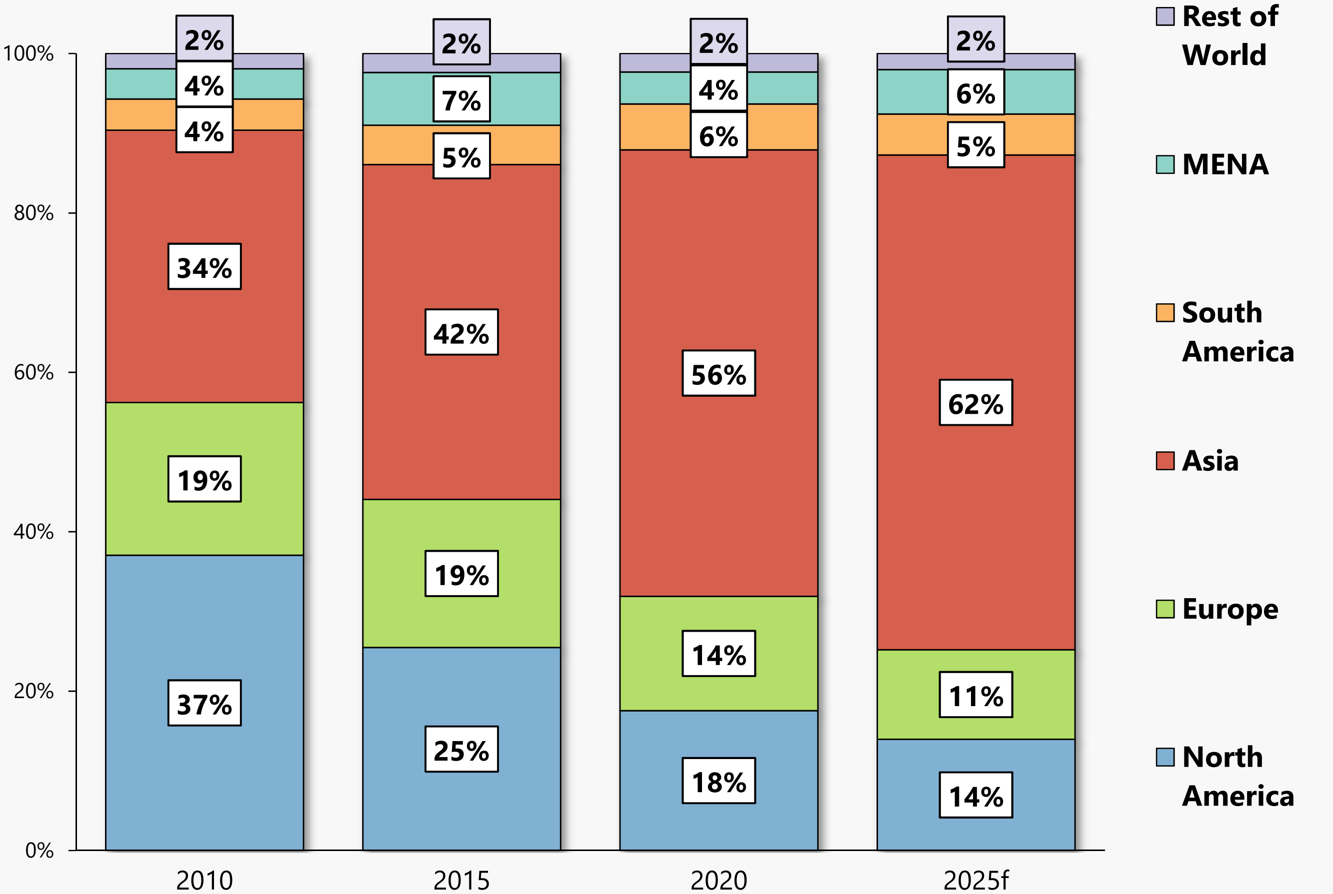
Additional support for growth will also come from environmental regulations that focus on preventing harmful materials from contaminating groundwater supplies.

As with some of the other end-use categories, Asia's production share has increased significantly since 2010 and is forecast to continue taking share. In 2010, Asia's share of global geosynthetics nonwoven production was 34%, while China's global share was 28%. By 2020, Asia's share had increased to 56% and China's to 48%. By 2025, Asia's share is forecast to rise to 62% and China's to 54% (Figure III-21).

Figure III-21

Geosynthetics Nonwovens Production Share by Region

(Tonnes)



Source: INDA/EDANA/ANFA estimates, 2021

Apparel

The apparel segment includes (non-medical) personal protective equipment (PPE), both disposable and durable, and general apparel, such as functional and performance clothing, interlinings, shoe/leather construction materials and apparel insulation.

While several of the nonwoven apparel categories are used in basic consumer clothing (e.g., dress shirts, suits, outerwear) and accessories, some are more technical in nature, providing the wearer protection or insulation.

Apparel is the smallest (in tonnage) of the nonwoven end-use segments, consuming 3% of the world's nonwoven material in 2020; this share has declined from 4% in 2010 (Table III-1 and Figure III-2).

The apparel market for nonwovens is now **primarily driven by product substitution**, in that as an engineered material, it can be designed to meet specific requirements; this advantage is driving growth in PPE and performance clothing. The other main driver is **legislation and regulatory control**. Protective apparel will be driven by increasingly strict safety standards and requirements in the advanced markets, and the introduction of standards and requirements in others.

The **main drivers** of nonwoven apparel product demand include

- product substitution, increasing proportion of functional and performance clothing that makes use of nonwoven material;
- general apparel design; and
- legislation and regulatory control.

Secondary drivers include

- Product innovation.

The rising demand of safety standard equipment to reduce accidents and uncertainties in industries is the key factor driving the market for PPE. Moreover, the emerging and developing markets are contributing to the growth of infrastructure which increases the employment and in turn triggers the demand for PPE.

New demands in protection levels require new technology solutions that are increasingly difficult for traditional textiles to meet.

In 2020, tonnage consumed by the nonwoven apparel end-use segment was 498,000 tonnes, a 3.2% annual increase from the 363,000 tonnes in 2010. By 2025 the end use will consume an additional 90,000 tonnes, reaching 588,000 tonnes, a 3.4% annual growth rate (Table III-10).

Table III-10

Apparel Nonwovens Production by Region

(Thousand Tonnes)

Region	2010	2020	2025f	Growth (AAGR) 2010-2020	2021-2025
North America	72	95	97	2.9%	0.3%
Greater Europe	70	63	53	-1.0%	-3.4%
Asia	161	291	376	6.1%	5.3%
South America	53	41	49	-2.4%	3.4%
MENA	6	5	11	-0.7%	16.4%
Rest of World	2	2	2	0.0%	0.0%
Total	**363**	**498**	**588**	**3.2%**	**3.4%**

Source: INDA/EDANA/ANFA, 2021

The forecast growth rate (4.1%, 2018–2023) for apparel nonwovens production from the last Worldwide Outlook for the Nonwovens Industry was comparable to the actual annual average growth rate of 3.2% (2010–2020) and of 3.4% in the more recent period (2015–2020).

Nonwovens tend to be a component of a garment or shoe construction. The apparel category is therefore classified by the component: apparel insulation, artificial leather, interlinings/interfacings and the numerous shoe components. The exception is personal protective apparel, in which nonwovens are also used in construction of those garments.

General Apparel

In traditional consumer clothing, nonwovens are used as interlining/interfaces, shoe components and linings, artificial leather, handbag components, padding, and insulation.

Nonwovens are used extensively in the traditional apparel industry for interlinings, clothing and glove insulation, bra and shoulder padding, handbag components and shoe components. In the late 1960's there were a few attempts to market disposable dresses but with little success. This occurred due to the uncomfortable properties of fabrics. But with the recent research a new type of disposable fabrics has been produced with better comfort, drape, hand, durability, stretch and recovery. These enhanced characteristics have compelled some to push aside the prejudices associated with these nonwoven fabrics and seek new unexpected venues.

In shoe construction, nonwovens are used as liners, counter liners, interlining, and reinforcing materials. Many of these nonwovens are used in the insole area to ensure a healthy foot climate and a high degree of foot comfort. Attributes nonwovens provide for footwear include being light weight, allowing moisture to pass through or be absorbed to enable foot temperature control, adapting for various finishes, uniform thickness, performance and look, abrasion resistance and high-tear resistance. In contrast to knitted linings, the nonwoven's multi-directional stretching properties enable uniform longitudinal and transverse stretching over the entire vamp area. Nonwovens' fine fibers allow shoes to be designed that are very soft in character and provide optimum comfort. The significantly lower weight-to-area ratio of the nonwoven-based material reduces the weight of the shoe while at the same time ensuring better shape retention.

Nonwoven interlinings are a layer of fabric between the fabrics of the garment. The interlining prepares its form, reinforces and prevents stretching. Even though interlining is an invisible part of a garment's interior, its construction and the fusion process and shell fabric influence sew-ability, durability, appearance and mechanical properties of the garment. Interlining is important in building shape into detail areas such as the fronts of coats, collars, lapels, cuffs and pocket flaps. It stabilizes and reinforces areas subject to extra wear and stress like necklines, facings, patch pockets, waistbands, plackets and button holes. Generally, interlinings are soft, thick, and flexible. Some are designed to be fused, while others are intended to be sewn to one or both layers of the textile. Interlinings can be treated with specific coatings like water repellent finish, stiffening finish, wrinkle free finish, or anti-microbial finish to enhance performance of interlinings with garment functionality. Special finishes help the commercial wash processes in garments. Nonwoven interlinings are now being printed with a customized design and laminated to the outer fabric. These materials can be used for unlined jackets and coats as well as trousers and skirts.

Nonwovens—in the forms of high loft, fiber fill, and Thinsulate™—are used as thermal insulation for jackets, outdoor sportswear, outdoor work wear, gloves, and accessories. Nonwoven insulation has come to largely replace feather-based down in providing the warmth and comfort inside a range of products for outdoor activities—from ski jackets and boots to sleeping bags. It is generally based on polyester fibers which are increasingly recycled and the materials are usually either needlepunched or thermally bonded. An area of growth is sustainable and recyclable insulation and padding.

Technology developments in spunlaid bicomponent polymers and hydroentanglement to create microfilament fabrics have opened up the use of nonwoven fabric as a viable option to replace woven fabric in sportswear, leisurewear, and work wear, presenting a significant opportunity for growth.

The incorporation of phase change materials (PCMs) into nonwoven fabric presents another area for significant growth. PCM technology was originally developed in the 1960s for use in NASA space suits. With the successful introduction of micro-encapsulated PCM (mPCM), this technology gradually became available to the consumer and industrial markets. This allows the creation of a thermo-regulating nonwoven material with textile sensation that provides high quality and comfort, and that is an optimal solution for winter clothing.

Another technology innovation in a nonwoven fabric is being used in sportswear to help regulate body temperature during physical activity. Superabsorbents are incorporated into the nonwoven fabric which works to keep the wearer's core body temperature stable. Cooling vests which use the fabric are activated by "charging" with water. The water enters the active nonwoven layer after being absorbed and distributed through a bacteriostatic textile fabric. Approximately 75% of the energetic processes in physical exertion are used for thermoregulation, limiting performance even at moderate outdoor temperatures. With higher outdoor temperatures or increasing skin temperature during sports activity, the water molecules which are bound inside the functional clothing absorb the thermal energy, evaporate from the large surface of the 3D nonwoven structure, and in turn cool down the wearer. Because of this process, the body sweats less and thereby saves energy that would usually be needed for thermoregulation. External cooling can therefore improve performance by up to ten per cent in hot conditions. The national football teams of Switzerland, Ireland and the U.S. use these cooling vests and headgear to improve their recovery during the half-time interval or before energy-intensive extra time. As well as sportswear, other applications for the fabric include occupational protective wear where there are risks of overheating and overexertion

Another novel apparel use are visors that keep the wearer cool through the use of a nonwoven. The headband area of head wear is lined with a strip of highly absorbent and water-retaining nonwoven spongy fabric with poly-vinyl alcohol. Embedded alcohol beads chemically react with water to lower the temperature of the material and slow down the drying process. The idea is to keep the temperature-sensitive pressure points along your forehead and back of the head cool longer.

Personal Protective Equipment (PPE)

In addition to the traditional consumer clothing, engineered nonwovens are used in the construction of personal protection equipment (PPE) clothing—typically full-body suits/coveralls—worn to minimize the risks associated with mechanical, electrical, fire, thermal, chemical, biological, water, impact, fall, and other hazards.

The protective textiles industry faces constant pressure to address a host of market demands. These can include functionality requirements, new and emerging threats in need of protective products, and the desire for improved performance and comfort.

This equipment includes a myriad of products, such as chemical protective garments and suits, firefighter turnout gear, high visibility garments, industrial fire retardant garments, and bullet-resistant vests, to name a few that are worn to minimize the risks associated with mechanical, electrical, fire, thermal, chemical, biological, water, impact, fall, and other hazards. Nonwoven material is an integral element in the construction of protective apparel. Protective clothing can be either a single-use product or a durable product.

Protective clothing is used in wide-ranging end-user industries such as oil and gas, construction and manufacturing, health care/medical, firefighting and law enforcement, mining, military, and many more. Protective clothing has a number of protective functions that range from thermal and chemical to mechanical, biological/radiation, and visibility.

Thermal and chemical items are the largest applications of protective clothing. Chemical protective clothing provides protection from hazardous chemicals in various forms such as liquid, gaseous, or vapor. Much of the chemical protective clothing is disposable and covered in the disposable section of this report. Thermal protective clothing offers protection from extreme heat, cold, electric arc, and fire. It is used in many industries, including energy supply for utility linemen, electricians, and oil and gas workers; metal production, firefighting, manufacturing, the military, and any other job that requires protection from fire or thermal events.

For durables uses, nonwovens typically are involved in a system combining fabrics and materials in a multi-layer solution. The various layers (fabrics) each have their own specific characteristics and are optimally geared to each other. With these fabrics an optimal balance must be struck between thermal protection and moisture regulation and cooling effects.

Nonwoven fabrics can be engineered to provide thermal (flame, heat, and arc flash) protection (e.g., wetlaid Nomex®, hydroentangled Komanda®) and used as a stand-alone material, but are used more frequently in layered or laminated construction. Nonwoven fabrics can also be engineered into a high-visibility material for use in protective apparel.

One of the largest consumer segments of nonwoven material in durable protective apparel is firefighter turnout gear. Modern turnout gear consists of a highly engineered three-component layered system with distinct performance and functional characteristics for each component. The three layers are the outer shell, a moisture barrier, and a thermal barrier. Nonwovens and nonwoven composites could be used in all three layers, but are primarily used in the thermal barrier. The thermal barrier provides the majority of protection from the intense heat and has the greatest degree of influence in isolating the body from the heat source. Traditionally, thermal barriers consist of a thin woven fabric known as the facecloth that is quilted to a nonwoven batt. The batt can be either needlepunched or spunlaced.

Key factors driving the protective clothing market include growth of end-user industries for protective clothing for thermal and mechanical applications. Strong governmental regulations requiring the use of protective clothing in industries have increased the demand for protective clothing. Factors challenging the growth of this market are high prices for specialized protective clothing and increased automation in some end-use industries.

Technology has dramatically redefined the durable protective apparel industry. The creation of advanced materials has transformed traditional fabric, chemical and metal production and continues to push the boundaries. New types of composite nonwovens and laminates, nonwoven finishing techniques, and superior fiber and textile additives are being incorporated into protective apparel. Materials are now being produced that can be manipulated, modified and tailored to precisely meet the needs of any particular customer or industry.

Greater demands in protection levels require new technological solutions, which have been increasingly difficult for traditional textiles to meet. Nonwovens can be engineered to meet and sometimes exceed those required performance attributes. This is providing nonwovens tremendous opportunity in protective apparel and opening new markets to nonwovens with new nonwoven materials and new technologies to replace existing woven materials. The incorporation of mPCM into the nonwoven fabrics of protective apparel should offer a significant opportunity for growth. Another example is needled carbon fibers nonwovens that provide protective and filtering properties against chemical and biological weapons. These are used in the military as linings woven into clothing.

Disposable PPE clothing is used for protection from low to medium-level hazards. The products under this category comply with all the environmental standards and can be easily disposed of. Disposable PPE garments provide workplace safety in "dirty" environments, to protect the person, and in "clean" environments, to protect the process or the product. They are used for personal protection in health and safety environments (including hazardous waste cleanup, emergency first responders, chemical handling, and agricultural applications) and for cleanroom garments; other industrial environments include painting, steel mills, and food processing, and in industrial cleaning applications, such as pressure washing and tank cleaning, petrochemical installations and environmental remediation protective uses.

Disposable PPE offers the combination of durability and lightweight comfort in environments that require chemical, liquid and/or oil protection.

Disposable PPE can offer head-to-toe protection with the use of shoe covers, hats, and masks. Cleanroom workers, for example, are completely enclosed in protective apparel—shoe covers, gowns, gloves, and hats or complete head cover similar to a diver's helmet—to act as a barrier to prevent particles generated by the wearer from contaminating the air. To prevent contamination while being manufactured, gowns and other products used in cleanrooms must be manufactured in cleanrooms themselves, and then packaged prior to transport.

The disposable PPE market has been in the press frequently, given the spread of the Ebola virus disease (EVD). Ebola measures less than a micron across and spreads through fluids. There can be millions of particles in a single drop of blood, and just a single viral particle entering the blood stream can cause a fatal infection. In the presence of Ebola, full-skin protection is recommended, so a person wearing a hooded suit should add boots, gloves, surgical masks, and eye protection (goggles or face shield). In certain situations—those involving large amounts of blood, other bodily fluids, or feces in the environment—additional PPE products (double gloves, overboots, leg coverings, and aprons) should be worn.

After the Ebola outbreak, significant design work was done in regards to the protective garments. Most PPE for chemical protection is designed to be taken off with assistance from another worker, but Ebola gear is different in this regard. Typically, Ebola clinic workers do not have a helper because they don't want to risk contaminating others with viral material. Manufacturers are designing suits that are easier for workers get in and out of. One thing they are considering is having a fabric that's a different color on the inside than the outside, so that when the wearer starts to remove the suit, they can have a visual cue of whether they're working with the clean side or the dirty side.

Another emerging trend impacting demand is using disposable clothing along with durable clothing. Disposable clothing is used in support to durable clothing to enhance their durability. Special application areas of disposable industrial protective clothing include specialist laboratories, disaster response, disease control, hazardous waste management, sewage treatment, emergency services and drainage construction.

In the protective apparel market, nonwovens continue to play an instrumental role by providing qualities such as comfort, breathability, high tensile strength, fire retardancy and water resistance.

Workers are demanding increasingly that their protective clothing not only safeguards their health in the workplace, but is also comfortable to wear, and manufacturers are responding accordingly. As a result, the use of high performance fabric with moisture management and thermal regulation properties has become widespread.

Technological innovations coupled with changing consumer need for protective clothing that combines safety with fashion and attractiveness are further estimated to drive market growth over the forecast period.

Region View

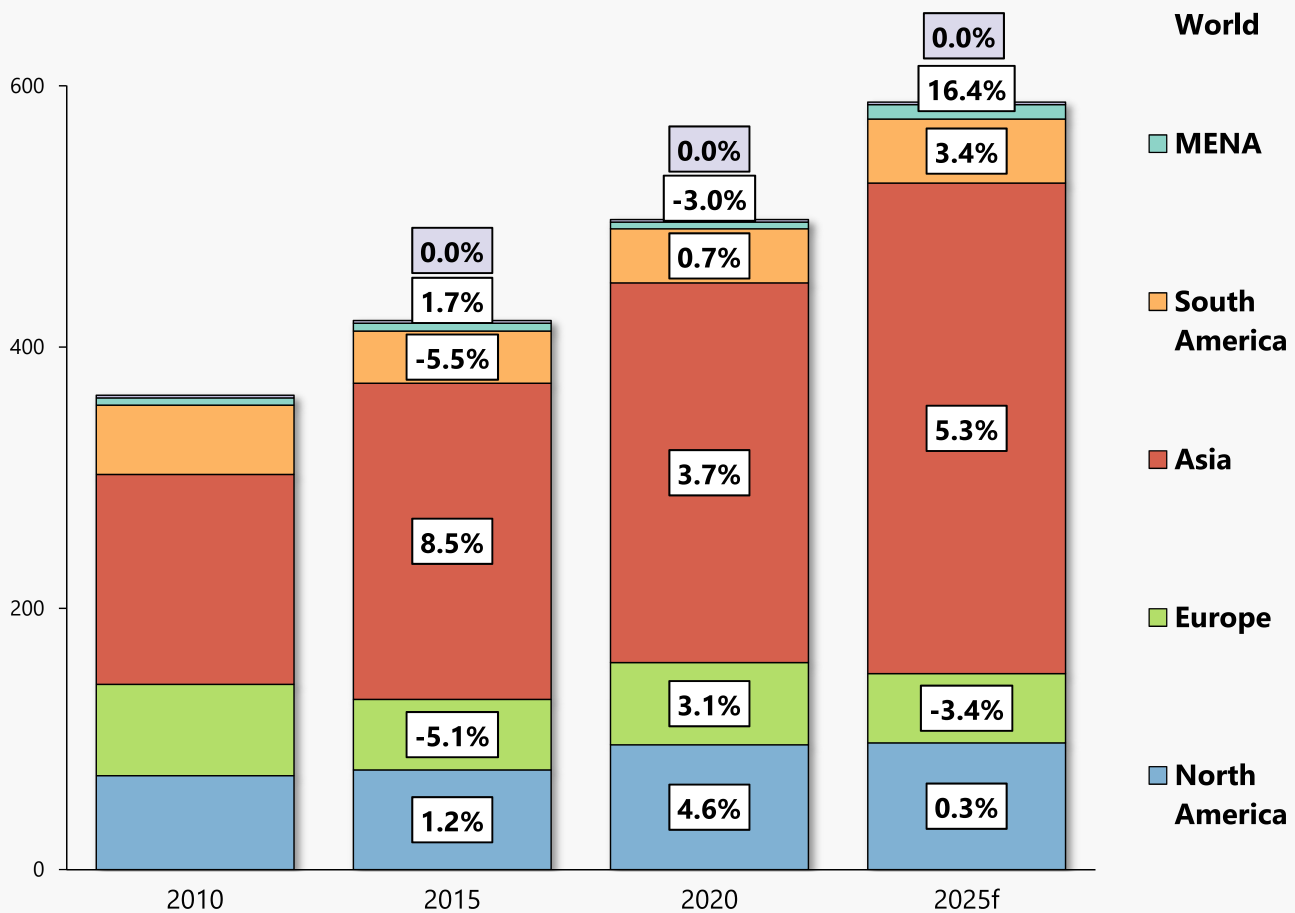
The Asia region—and its many low-cost labor countries—will continue to lead the regional growth. In the previous ten years, Asia's average annual growth of apparel nonwovens production was 6.1% annually; this compares to all of the others region's (not including Asia) average annual growth rate of 0.2%. Going forward, Asia will continue to lead the growth, expanding 5.3% annually through the forecast period (2021–2025), compared to remaining regions' forecast of 0.5% (Figure III-22).

Figure III-22

Apparel Nonwovens Production by Region

(Thousand Tonnes)

Annual Percent Change (AAGR) from Preceding Five-Year Period



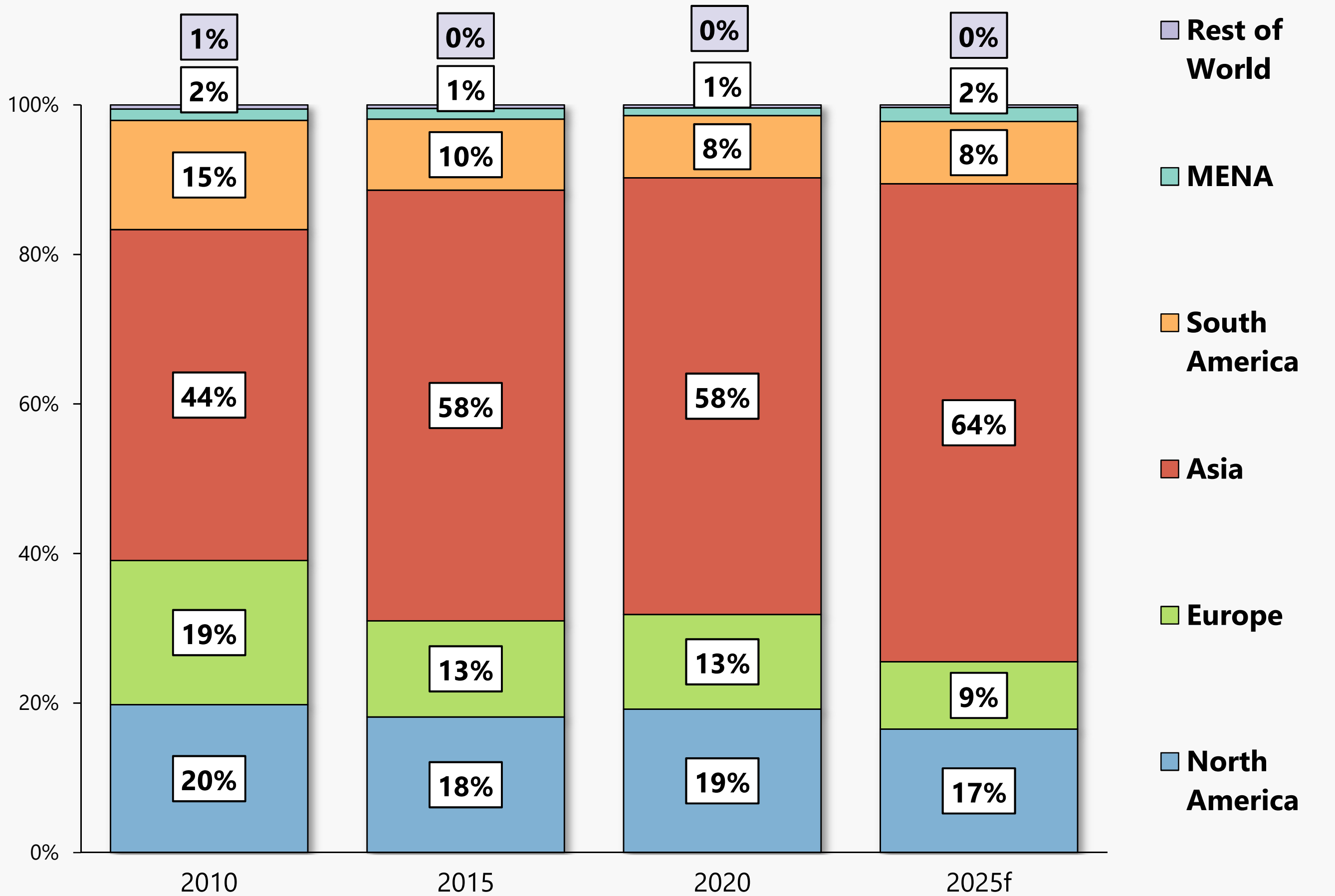
Source: INDA/EDANA/ANFA estimates, 2021

This market segment is highly dominated by Asia, which accounted for more nearly half (44%) of the global nonwoven apparel production in 2010. This share is projected to increase through the forecast period, reaching 64% by 2025 (Figure III-23).

Figure III-23

Apparel Nonwovens Production Share by Region

(Tonnes)



Source: INDA/EDANA/ANFA estimates, 2021

Other End Uses

The other end uses segment includes numerous and varied products of both a single-use nature and that of a durable nature. The other end use is the second largest (in tonnage) of nonwoven end-use segments having consumed 14% of the world's nonwoven material in 2020. The segment is forecast to maintain its share though the forecast period (Table III-1 and Figure III-2).

Due to the sheer number and uses of products in the other end uses, there are no primary drivers; however, product innovation is a driver of many uses—as a nonwoven is an engineered material, it can be manipulated to meet a myriad of specific performance attributes—and convenience is a driver for the single-use products.

The single-use products in the other end-uses category include

- bedding products (headrest covers, pillowcases, sheets);
- cleaning/scrub/ and abrasive/polishing discs/pads;
- envelopes;
- fabric softener dryer and dye scavenger sheets;
- oil/chemical sorbents (industrial and spill response), in the form of mats/pads, rolls, socks, and oil sorbent booms/sweeps;
- packaging materials (e.g., absorbent food pads, bale wrap, can separators, cargo covers, thermal insulation);
- tabletop products (napkins, table covers, cutlery wraps, basket liners);
- tape substrate; and
- other disposables.

The durables products in the other end-uses category include

- durable graphic papers (art, maps, book covers);
- electronics, (lead battery separators, other battery separators, and cable insulation/wrap);
- fabric graphics (banners, signage);
- fabric structures;
- felts (craft/decorative, equestrian, erasers, industrial, tennis ball, etc.);
- paper-making felts;
- tote/promotional bags; and
- other durables, including composite structures not classified elsewhere, such as nonwoven glass prepreg for windmill blades.

In 2020, the other nonwovens end use consumed 2.543 million tonnes, an annual increase of 6.3% from 2010, an incremental increase of over a million tonnes (1.161 million). By 2025 the end use will consume an additional 326,000 tonnes, reaching nearly three million tonnes, a 2.4% annual growth rate (Table III-11).

Table III-11

Other Nonwovens Production by Region

(Thousand Tonnes)

Region	2010	2020	2025f	Growth (AAGR) 2010-2020	2021-2025
North America	395	563	612	3.6%	1.7%
Greater Europe	175	282	341	4.9%	3.9%
Asia	776	1,637	1,829	7.8%	2.2%
South America	21	48	57	8.6%	3.2%
MENA	14	12	30	-1.6%	19.6%
Rest of World	0	0	0	n/a	n/a
Total	**1,382**	**2,543**	**2,869**	**6.3%**	**2.4%**

Source: INDA/EDANA/ANFA, 2021

Single-Use Products

One of the larger product categories within the single-use other end uses is **sorbents**. Sorbents, primarily designed to attract oily material, are designed in many forms, from booms to float in the ocean for spill response to pads used in a shop floor for day-to-day use. Multiple materials can be used for sorbents; the small fiber sizes and hydrophobic nature of polypropylene make meltblown a popular choice.

All of the meltblown used in oil sorbent is polypropylene (PP), as meltblown polypropylene fibers in their natural state are hydrophobic. Hydrophobic fibers repel water while only adsorbing oils and other hydrocarbons because they are oleophilic. These products have such a high affinity for oil that it is possible to completely saturate a PP meltblown web with water and subsequently have that water completely displaced by oil, through simple contact with a mixture of oil and water. In the oil sorbent application, the fine microfiber structure creates microcapillaries that greatly aid in the rate of adsorbency and the wicking action necessary for full use of an oil sorbent product. PP meltblown fibers can adsorb up to 25 times their own weight—due to the large surface per a given unit—with approximately 35% of the oil collected being recoverable or used as highly combustible media.

The sorbent market is segmented into industrial (~70%) and spill response (~30%). The industrial products are used in industrial plants, machine shops, and maintenance shops, while the spill response products are used to clean up environmental oil spills on water or land. Industrial products come in the form of pads and mats to keep floors slip free or placed under machinery, and rolls and socks that are up against machinery.

Industrial meltblown products make use of a color-coding scheme for disposal purposes. Some of the meltblown products may be coded in one color for water absorption, while another color may indicate oil or chemical that has to be disposed of as hazardous waste.

Loose-stacked weave construction increases surface area and begins to sorb on contact, making it ideal for quick, effective clean-up of large oil spills on land or water.

For spill response, floating oil booms are employed. Meltblown is placed in a long, porous tube, generally consisting of a polyester or polypropylene structure. Boom products are typically either 4- or 8-inch diameter devices that are 10 feet long and coupled with hardware that allows them to be coupled to form any desired lengths. Such a boom can contain an oil spill and also soak up the oil to the saturation point. Booms or snakes of more moderate length (4 feet) and circumference (3- to 4-inches) can be used to encircle operating equipment and contain leaks or spills, thus minimizing ground water contamination and related problems.

Sorbent sweeps are variations of booms, but planar. Sweeps are usually narrower and have ropes attached at the top and bottom edges to allow two people to pull these sweeps across the water surface to remove any remaining surface sheen.

While this application makes use of polypropylene's affinity for oil and is very useful, the effectiveness of the product is not critically dependent upon a specific fiber property or dimension.

The **scrub/scouring/abrasive/polishing/conditioning pad/disc** market, which includes both consumer and industrial applications, is another of the larger markets in the other category. The green scouring pad, sometimes combined with an absorbent sponge, is a typical consumer application. These pads are available for heavy-duty and light-duty applications. The light-duty pads have been engineered to use on delicate surfaces like chrome, ceramic, glass, and stainless steel appliances.

Nonwoven cleaning floor discs/pads are also used for the sanitary services market. These heavily coated products are used in the rigorous polishing, buffing, cleaning and stripping of surface. The industrial market is more varied, using the nonwoven pads not only for floor scrubbing and scouring but also for grinding, surface conditioning, abrading, polishing, finishing and cleaning of objects to give them the required shape and finish. These pads are made with diverse levels of coarseness to ensure proper application in the removal of rust, grease, and scuff marks from floors.

Some of the pads have abrasive particles dispersed throughout the fibers and bonded to the nonwoven with the help of synthetic resins such as phenolic, epoxy, and others. By varying the dimension of the synthetic fibers, the firmness or flexibility of the material can be manipulated. Abrasive minerals used in nonwovens include ceramic, aluminum oxide, silicon carbide, and agglomerated abrasive.

High-performance nonwoven abrasive pads can be used for aerospace and automotive applications such as exterior and interior airframe maintenance and repair, stripping and painting, and engine rebuild and maintenance, construction, cookware, and medical industries. The extra-heavy-duty nonwoven discs remove weld lines, weld splatter and weld discoloration, and blend surfaces in a single step. Nonwoven discs are well-suited for both aggressive weld removal and surface blending on steels, and work well on softer metals/alloys. One of the unique uses is in the area of artificial eyes. Customized artificial eyes are handmade from medical-grade acrylic plastic and finished with the nonwoven abrasive pads.

Packaging—especially in Asia—has been one of the fastest growing product categories within the other single-use end uses. Nonwovens are used as packaging material for highly sensitive parts and they provide enhanced surface protection together with significant operation savings. In the packaging market, nonwovens are becoming more popular, thanks to their production cost, properties and wide range of basis weight. The primary advantages of nonwovens are the combination of strength and lightweight properties. In applications where protective wrapping is required, soft surface textures can offer scratch resistance. There is an expanding use of nonwoven to pack electrical and computer parts. Nonwoven layers are often used to protect laptop screens. Spunbond nonwovens are appearing as the “soft” facing material in both bubble wrap and corrugated packaging when used with easily damaged products.

Nonwovens have a highly durable, soft and smooth surface that is scratch-resistant, breathable and can be completely lint-free, preventing damage to the item being shipped. Nonwovens for packaging are used in consumer electronics, automotive, aerospace, consumer appliances and fixtures (lighting and fittings), apparel (primarily shoes), pharmaceutical, and cosmetic and perfume packaging. Nonwoven packaging materials can also include anti-static, water-repellent and ultraviolet light protection treatments.

Packaging nonwovens are used for protection and wrapping either as fabric or finished as tubes, pouches, bags, sacks or containers to package or wrap objects or to serve as a filler.

Perishables found in the grocery store such as meat, chicken, fish and produce rely on nonwoven absorbent food pads underneath them to soak up excess liquids and keep the foods fresh. Airlaid short-fiber with food grade superabsorbent polymers (SAP) are the primary nonwoven used in food pads, but spunbond/SAP/spunbond laminates are also appearing. In this market airlaid short-fiber is ideal because a food pad has some of the same requirements as a hygiene absorbent core: quick acquisition rates, no/low rewet, absorbency capacity.

Controlling moisture within food packs aids shelf life and reduces waste. Packaging that incorporates nonwovens as components to aid pack breathability can manage the respiration and the shelf life of certain products, such as fruit.

Like fruit, pharmaceutical products are often highly sensitive to external influences. In terms of packaging, this means that the packaging materials need to be durable and meet the legal standards for hygiene and sterilization of the medical product they contain.

A large amount of nonwovens are now being used to wrap and protect vehicles from manufacturing to the showroom. Cargo covers, in addition to providing outstanding screening from solar radiation, extends the performance benefits by offering cold temperature protection. The nonwovens, being inherently air permeable, help control humidity levels underneath the cargo cover in order to stop the formation of damaging condensation. Condensation is an inevitable by-product when goods are moved from hot to cold environments and where products and packaging release moisture when being moved from cold to hot environments. They provide tamper-protection, are fully weather-resistant and offer a highly effective barrier against air-borne contamination such as dust, pollen and bird droppings.

Similar to cargo covers is bale wrap. Bale wrap is a single layer nonwoven recyclable polyester fabric suitable for use as bale covering having high strength and resistance to tears and abrasion and to which labels can stick. For many years fiber producers have sought a solution to the problem of wrapping bales of fibers to protect the fibrous material from contamination and damage during shipping. The cotton industry has sought a solution to the problem of wrapping cotton bales to protect the bales from contamination and damage during shipping. Some wraps that were commonly used were jute or burlap. These have the disadvantage of being loosely woven, admitting contaminants into the cotton bale, and are susceptible to tears, rips and holes that expose the wrapped cotton to contamination during storage and shipping.

A new and novel—nonwoven consuming—product development is being used for the delivery of mattresses. A heavy-duty, nonwoven branded bag not only protects the mattress during delivery, but also helps ensure a cleaner delivery into the consumer's home. Once the sleep system is delivered and set up, the nonwoven mattress bag is folded and presented to the consumer who can then store the bag for future use.

Another recent innovation is a biodegradable nonwoven cotton-based thermal insulation liner for temperature-control packaging materials for not only shipping fruits and vegetables but also meal kits and wine. This material is a sustainable and environmentally friendly insulation, as opposed to the majority of other shipping insulation materials.

In the forecast period, continued strong growth is forecast for the packaging materials, and for entirely new nonwoven uses that would not fall into the other end-use categories. This could easily change, as the sorbent market could be significantly impacted by an oil spill disaster.

Durable Products

Within the durables end uses, electronics is the largest category of the other durable applications and includes battery separators, cable wrap, cable insulation, and wearable technologies. A nonwoven material on some wearable technology items are now being placed between the skin and the hardware or casing of the item.

The **electric component market** consists nearly entirely of the energy storage market or battery separators. The battery separator market is a niche field for nonwoven producers, with the products representing only a fraction of the overall battery market. An important functional item in batteries is the separator, which in many battery designs is made of a nonwoven fabric. A separator is a permeable membrane placed between a battery's anode and cathode. The main function of a separator is to keep the two electrodes apart to prevent electrical short circuits, while also allowing the transport of ionic charge carriers that are needed to close the circuit during the passage of current in an electrochemical cell. All commercial batteries use separators, though different types of battery systems require different types of separators.

Battery production primarily uses drylaid nonwovens, wetlaid nonwovens, meltblown fabrics and spunbond fabrics as separators. These are usually still needled or hydroentangled to obtain certain properties, e.g. a larger surface by means of felting. Depending on the respective manufacturing process and field of application, nonwovens are subsequently further equipped in order to generate additional special effects: Hydrophilization (increase in fluid intake capability) and ceramic equipment are just two options for increasing the efficiency of a battery.

The precise manufacturing processes required for these products are aimed at achieving tightly controlled fiber formation, uniform pore structure, chemical stability, high wicking and absorbency, mechanical strength, and accurate control of thickness and weight. Nonwoven battery separators tend to be either wetlaid glass or meltblown polypropylene. Nanofibers can also be incorporated onto the nonwoven material.

Nonwoven material is used in lead-acid (automobile battery) nickel-cadmium (NiCd or NiCad), and lithium-ion batteries, as well as in fuel cells. While a fuel cell is an electrochemical device similar to a battery, it differs in that it is designed for continuous replenishment of the reactants consumed in the unit. It produces electricity from an external fuel supply, and so does not have the limited capacity of a conventional battery. Nonwovens have potential use in the membrane systems of fuel cells and in filtration systems for the products flowing into the system.

Today, lead acid batteries are the most cost-effective energy storage devices storing electricity from renewable energy resources, providing back up for data centers, supporting supply chain management, enabling vehicle start-stop systems and supporting electrical car charging stations.

As the market for consumer products such as hybrid cars grows, the use of batteries as a key component will grow in importance. Typical hybrid cars contain between 50 and 70 lithium-ion batteries, plug-in electric vehicles with range-extending motors have 80 to more than 200 batteries, and fully electric vehicles carry 150 or more.

One of the earliest uses of spunbond polyester fabrics was for electrical wire and cable insulation. As the growth of electronic and optical cables has escalated, tapes made of nonwovens, which include additives such as carbon fiber and superabsorbent powders, are now widely used. The incorporation of the superabsorbent materials in the cable protects against cable failure due to water intrusion.

The applications being explored for nonwovens in the field of energy generation and storage are extremely diverse, ranging from advanced battery separators in new charging devices to temperature stabilizing systems and engineered materials capable of being packed with power.

Nonwovens are finding their way into the electrotechnical industry. Meeting these numerous requirements constitutes a major challenge for separators. Possible battery separators include microporous polymer membranes, inorganic composite membranes, and nonwovens. Price is a further important criterion in the selection of a suitable separator. In this emerging industry, constant pressure on prices, the ever more economical production of nonwovens, diversity in the choice of raw materials, and the high number of possible variations are all sharply increasing demand for nonwovens.

Fabric graphics is another large and growing application in the other durables category. The majority of fabric graphics are either woven (~88%) or vinyl (~8%) with a small—and growing amount—being nonwovens (3%). The retail segment continues to expand the soft signage market with both indoor and outdoor signage and there continues to be more sales of high-end point-of-purchase substrates. Nonwoven fabric graphic material has been taking share away from vinyl as it is more ecologically friendly. Nonwoven has a greater share of the outdoor fabric graphics as it stands up to the weather better. Nonwoven material allows faster printing speeds, especially wide-format printing, so as printers update machinery and move to higher speeds, the usage and share of nonwovens will grow.

Fabric structures are types of constructed fabric that provide end users a variety of aesthetic free-form building designs. Custom-made fabric structures are engineered and fabricated to meet structural, flame-retardant, weather-resistant, and natural force requirements. Fabric structures are considered a subcategory of tensile structure. Nonwovens also have a small—and growing share—of the fabric structure market, estimated at 5% in 2018.

A difficult segment to measure within other durable applications category is the use of **composites**, as more and more materials are being created to meet the needs of a growing number of applications. A composite is a mixture of two or more chemically different and insoluble materials, with at least one of the layers being a nonwoven. Nonwovens are sometimes used as a substrate to build other composites (carbon fibers, glass fibers, natural fibers, metal matrix, and ceramic matrix) upon. Nonwoven composite material can range from two to more than 20 layers of material. Composites materials tend to make use of "prepreg." Prepreg is the common term for a reinforcing fabric which has been pre-impregnated with a resin system. This resin system (typically epoxy) already includes the proper curing agent. As a result, the prepreg is ready to lay into the mold without the addition of any more resin. In order for the laminate to cure, it is necessary to use a combination of pressure and heat.

Glass fiber-based nonwoven prepreg is expected to remain the largest fiber type in the global nonwoven prepreg market during the forecast period, driven by the wind energy industry. Increasing wind blade length needs a material which has high load-bearing properties. Nonwoven prepreg based blades provide higher load-bearing capacity than woven prepreg based blades and are highly suitable for longer wind blades. Carbon fiber-based nonwoven prepreg is still in its relative infancy.

Composite nonwoven materials include the common items such as skis and surfboards to the larger uncommon items like windmill blades and airplanes (included in the vehicle construction category). Composite applications continue to grow and evolve in a wide variety of markets and even broader assortment of performance-based end uses, including military applications.

Other durable application categories include tote bags (strong growth is forecast for this area with continued penetration into the grocery bag market), paper machine press felt/clothing, and other industrial felts items such as gaskets, seals, and sound deadening material for machinery.

The forecast is for steady—but slower than historical—growth for the other durables applications, given the slowing of the economy offset by the trend for nonwoven materials to take share away from other materials, and the introduction of nonwoven materials into completely new markets.

Region View

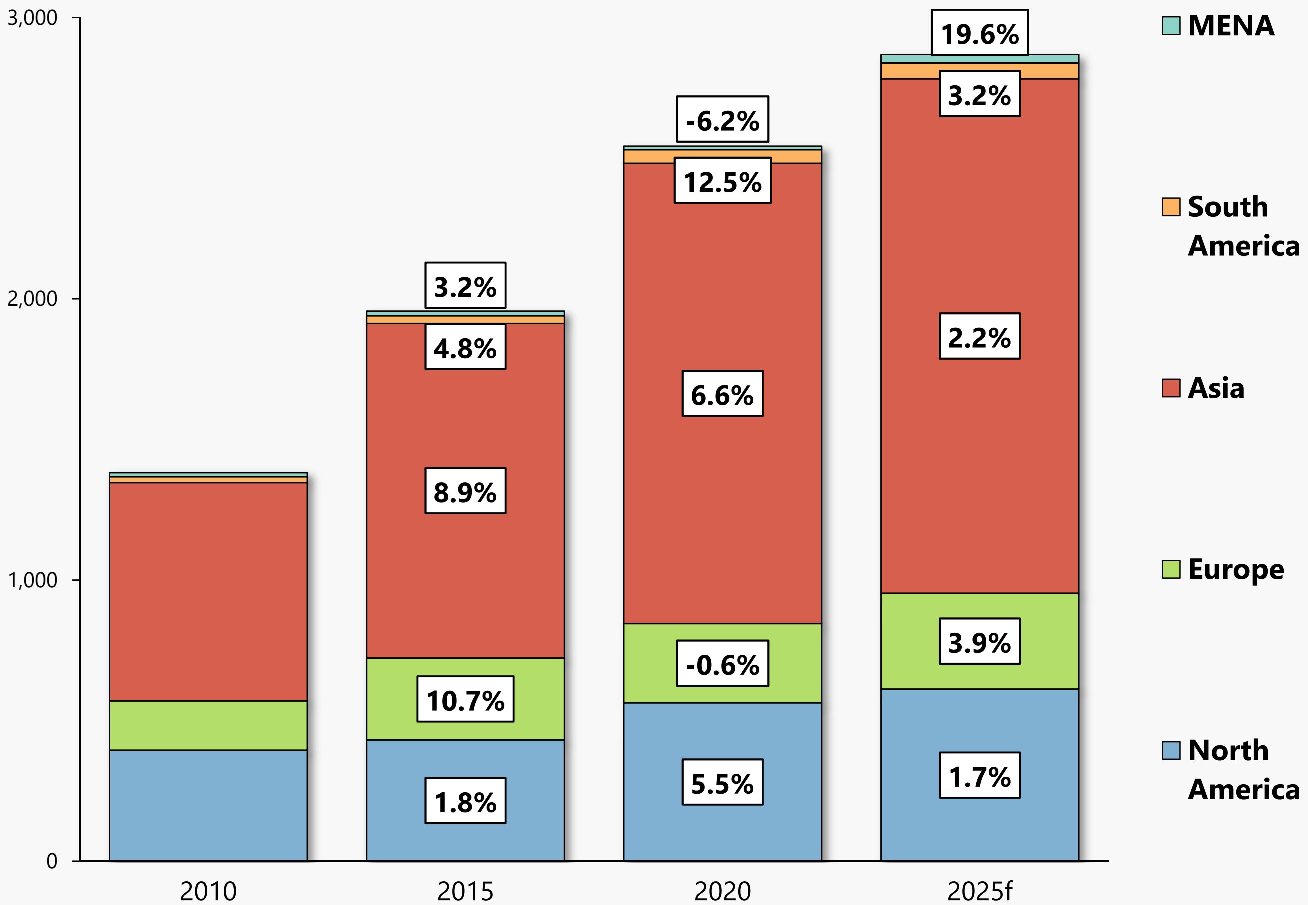
Asia is the dominant region for the other end uses, especially lower-cost items, such as those in packaging and tote bags. The Asia region expanded at 7.8% average annual growth rate from 2010 to 2020, adding an incremental 861,200 tonnes. All the other regions combined added only 300,000 tonnes, a 4.1% average annual growth rate. Going forward to 2025, it is forecast Asia will add an additional 192,000 tonnes of production to meet the other end-use products demand, a 2.2% average annual growth rate. The other regions combined will add an additional 134,000 tonnes, a 2.8% average annual growth rate as some of the lower cost items being produced in China for use in North America will likely shift to the South America region (Figure III-24).

Figure III-24

Other Nonwovens Production by Region

(Thousand Tonnes)

Annual Percent Change (AAGR) from Preceding Five-Year Period



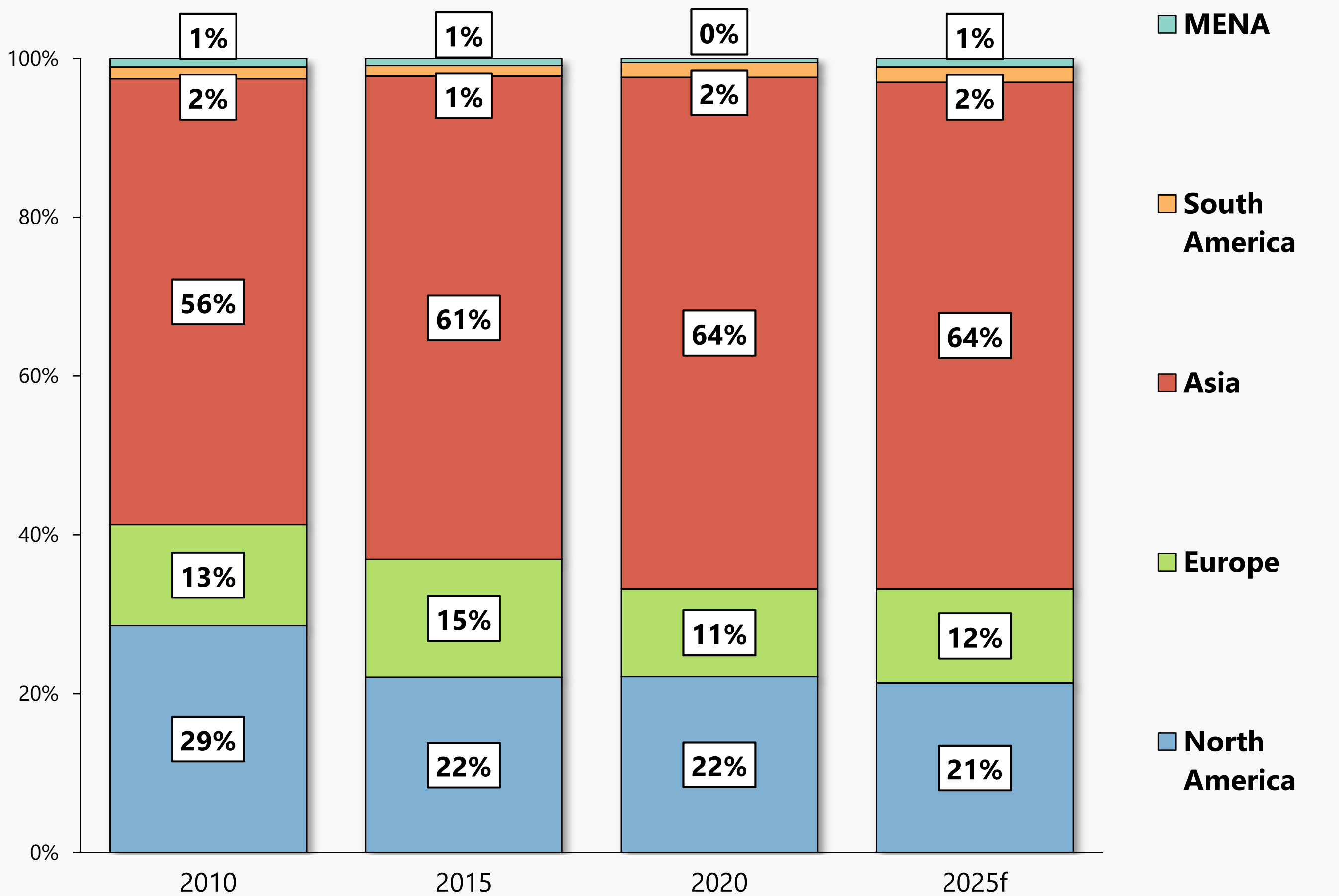
Source: INDA/EDANA/ANFA estimates, 2021

As stated, Asia, the dominant region for the other end uses, accounts for two-thirds of the end-uses production. Asia's share has stayed and is forecast to stay relatively the same (64%) of the end-uses' production (Figure III-25).

Figure III-25

Other Nonwovens Production Share by Region

(Tonnes)



Source: INDA/EDANA/ANFA estimates, 2021

IV. INTERNATIONAL TRADE FLOWS

The year 2020 will remain in history as the year of the beginning of the reshaping of globalization. The world economy recorded its deepest and most synchronized collapse. Factories shut down, countries closed, goods and people stopped crossing borders and the world trade shuddered. Firms found long supply chains to be unwieldy and risky. They worried not just about possible trade wars and the tariff duties applied, but also about their environmental footprint.

These general comments and conclusions did not apply to the nonwovens industry and the international trade of roll goods which, as we will see below, accelerated further in 2020. Global demand for absorbent hygiene, protective medical apparel and face mask/respirator nonwovens exploded. Production increased thanks to high, or very high, utilization rates of capacities, and new lines were added. Despite tariffs, the limited availability of containers and other constraints, global trade flows of roll goods has never been as high as in 2020. For many countries, imports of nonwovens materials were crucial to fight against the pandemic.

However, this acceleration doesn't mean that a new globalization and a reorganization of supply chains could not also happen within the nonwovens industry in the near future. The logic of reshoring or near-shoring and of sourcing again locally to supply key products could take precedence over the current policies and/or companies' strategies. For instance, in medical applications (such as personal protective equipment) or in electric vehicles, governments could be more likely to shorten and diversify supply chains to avoid facing again shortages and dependence on a single country.

Coverage and Limits

This chapter on international trade flows provides a detailed analysis of the trade of the main countries/regions manufacturing nonwovens "roll goods." Nevertheless, it is important to have a clear understanding of the coverage and the limits of official trade figures described hereafter.

One of the main purposes of official merchandise trade statistics is to adequately describe economic phenomena and provide decision makers with relevant indicators. Yet, the structural changes linked to globalization are challenging the relevance of these traditional trade statistics, and these registered flows may also misrepresent the business and market behavior. Indeed, international supply chains that characterize global manufacturing, particularly since the 1990s, are also affecting trade, as firms in industrialized countries look beyond the boundaries of the developed world to lower production costs (energy and/or raw materials) and access new talents.

This edition of the worldwide report covers the period 2010–2020, so the analysis of trade flows hereafter is heavily impacted by the very unusual levels recorded in 2020, which were not in line with the long trends and cannot definitively be considered as benchmarks for future developments. Moreover, evolution of imports and exports are difficult to predict as companies' trade strategies can vary according to current trade conditions.

Table IV-1

Nonwovens in Harmonized System Nomenclature

Codes	Definitions
5603	Nonwovens, whether or not impregnated, coated, covered or laminated:
Of man-made filaments:	
5603.11	Weighing not more than 25 g/m^2
5603.12	Weighing more than 25 g/m^2 but not more than 70 g/m^2
5603.13	Weighing more than 70 g/m^2 but not more than 150 g/m^2
5603.14	Weighing more than 150 g/m^2
Other:	
5603.91	Weighing not more than 25 g/m^2
5603.92	Weighing more than 25 g/m^2 but not more than 70 g/m^2
5603.93	Weighing more than 70 g/m^2 but not more than 150 g/m^2
5603.94	Weighing more than 150 g/m^2

Source: World Customs Organization, 2021

Trade flows described hereafter are the ones recorded in Chapter 56 (Wadding, Felt and Nonwovens; Special Yarns; Twine, Cordage, Ropes and Cables and Articles Thereof of the Harmonized System (HS), the global system of nomenclature that is used to describe most world trade in goods. Within Chapter 56, this report provides data on heading 5603 (Nonwovens, whether or not impregnated, coated, covered or laminated).

Subheadings of HS5603 propose first a classification of the materials by production process differentiating "Of man-made filaments" (theoretical polymer-based) and

"Other" (theoretical fiber-based). There is no clear usage by importers and exporters in the use of those distinct differences. Based upon research, "nonwovens of manmade filaments" was intended to collect spunlaid trade data; while "nonwovens other" would then be intended to collect staple fiber. However, in the Harmonized Tariff Schedule (HTS) there is no clarification or definitions of what those are intended to be. Being that much of the staple fiber is produced as a manmade filament, the use of these differing codes causes confusion, in addition to trade rulings that include examples of each in both codes.

A further sub-division according to the weight of the materials is applied. The nomenclature includes four basic ranges of weight: less than 25 grams per square meter (gsm), between 25 and 70 gsm, between 70 and 150 gsm and greater than 150 gsm (Table IV-1).

This official nomenclature for nonwovens materials is quite simple and does not reflect the complexity of our industry. Therefore, this simple classification shows some obvious limits. In regards to the **misnomer of roll goods**, the introduction to Chapter 56 states: Headings 5602 and 5603 cover respectively felt and nonwovens, impregnated, coated, covered or laminated with plastics or rubber whatever the nature of these materials (compact or cellular). Heading 5603 also includes nonwovens in which plastics or rubber forms the bonding substance. Notably it states: Headings 5602 and 5603 do not, however, cover: Felt impregnated, coated, covered or laminated with plastics or rubber, containing 50 percent or less by weight of textile material or felt completely embedded in plastics or rubber (chapter 39 or 40). Conversely, it would then **include materials in which 51% or more of the weight is nonwoven material** and the remaining material could be laminate material or material to make a finished good. It is not 100% nonwoven roll good trade, but **includes both composites and finished goods**. It would be more applicable to call this the trade of Nonwoven Rolls and Converted Products Consisting Primarily of Nonwovens, hence forth the term rolls goods includes both nonwoven rolls, nonwoven laminate rolls and nonwoven finished goods where the nonwoven weight is greater than fifty percent.

Available figures are only in tonnes and in value for the nonwovens classified in the chapter 5603 of the Harmonized System (HS) nomenclature. Moreover, possible intra-company trade may impact trade figures in value. This is the reason why trade flows are mainly analyzed in tonnage hereafter.

There isn't any differentiation by raw materials, polymers and/or fibers and/or chemicals used during the production process which is provided in the official nomenclature, while the composition of the roll goods has a definitive impact on the final characteristics, the technical properties and the price of the nonwovens.

With only four ranges of possible products' weight, the trends linked to the substitution by lower grammage products are also difficult to identify.

This official classification of nonwovens does not include the whole range of possible bonding technologies, and, therefore, their respective trends also cannot be monitored.

It is also important to remember that some nonwovens—mainly wetlaid and airlaid—made of more than 50% wood pulp or non-textile fibers are usually classified in the official nomenclature according to their raw materials and not in the nonwovens HS5603 headings analyzed here. As these types of roll goods are grouped together with other kinds of products and not clearly differentiated in the official nomenclature, the only relevant and accurate information on these sorts of products, as far as Europe and Middle East are concerned, can be found in the EDANA annual statistics.

Further Chapter 56 is in Section XI, Textile and Textile Articles, of the Harmonized Tariff Schedule. As a result, some nonwoven rolled goods—specifically glass, carbon, and metal-coated fibers—are not included in the 5603 codes, as they are not considered a textile, even though the industry would consider the item a nonwoven roll good.

Additionally, the flows of nonwovens coming in and out of a region are not only roll goods going across the borders. Final and other intermediate products made, partially or entirely, of nonwovens should also be taken into account, in particular when we need to calculate the nonwovens consumption of a specific region or country, but this can only be achieved within the limits of the current official trade nomenclature. The uses of nonwovens are so diversified and most of the time not clearly identified in the nomenclature that it is not possible to trace their movement through the different supply chains.

For all these reasons, official trade statistics are unclear for nonwovens because the information collected by customs does not fit the modern characteristics of the nonwovens industry. This is an obvious constraint in the subsequent analysis.

Anyway, major developments in trade flows are captured through these official figures. In order to help its member companies, EDANA has developed a comprehensive database for nonwovens, polymer and fiber-based products, for import and exports, in tonnes and in euros, for 68 declaring countries, including the nonwoven trade flows of the most important suppliers of nonwovens since 1999. The most important trends observed over the last decade are disclosed hereafter, but additional information is available upon request.

This chapter will focus on the trade flows of the "roll goods" and show their development over the last ten years. As described in previous sections, production showed impressive growth rates during this period in the different regions, and despite the intrinsic characteristics of nonwovens, exchanges between countries grew as well.

The idea here is not to explain why such growth in trade has happened—as cause can be very different from year to year (such as intra-company strategy, regional overcapacities or the impact of the sanitary crisis), from product to product (limited analysis of the trend in gsm due to the HS nomenclature), and from raw materials to raw materials (nonwovens are not classified by their components)—but to show the current status of the worldwide trade of nonwoven roll goods.

Growing Importance Of Trade In Nonwovens

This chapter focuses here on the trade of nonwoven roll goods, the visible part, and not on nonwovens as huge volumes of nonwovens that move between countries and are finally consumed through their end uses. For instance, Chinese nonwovens can be molded in a door panel of a Japanese car finally crisscrossing the streets of Paris.

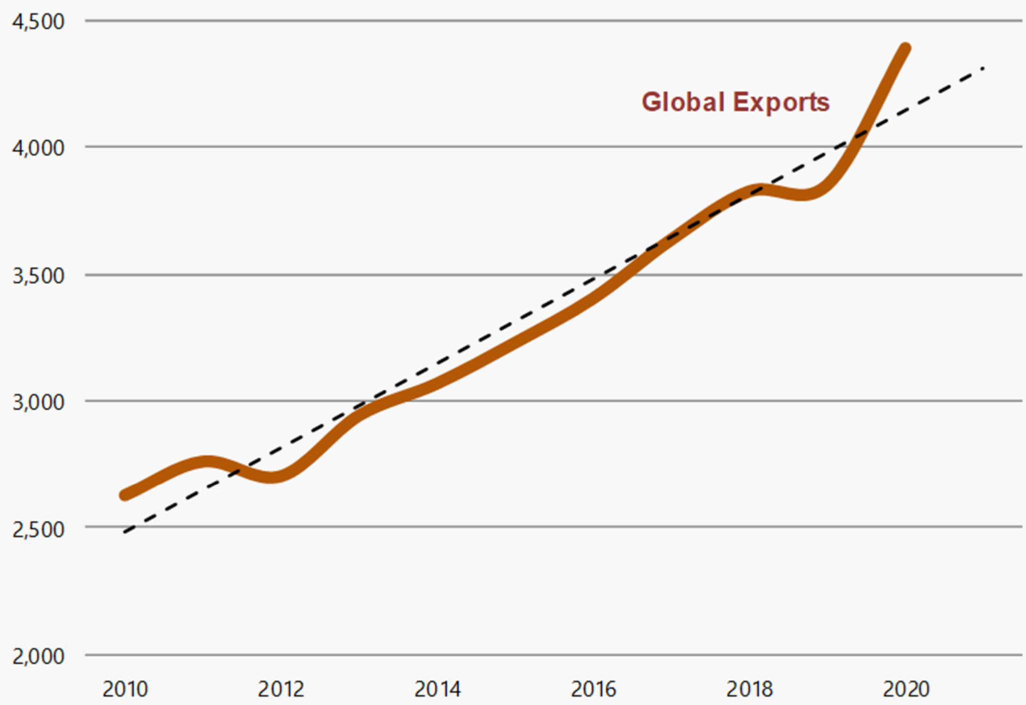
After the slowdown recorded in 2009, the trade in nonwoven roll goods has been steadily growing over the past decade (Figure IV-1). The trend is associated with a number of developments: growth and increased sophistication of production has given birth to strategies involving fragmentation and reorganization of firms' activities, both in terms of ownership boundaries and location for production.

Despite the bulky characteristic of many nonwovens, a continuous expansion of global trade of roll goods has been recorded. This was particularly true in 2020. Although a stabilization was observed in 2018-2019, the pandemic exacerbated the need for nonwovens worldwide and increased the trade flows between countries. Volumes exported in 2020 were 14% higher compared to 2019, which was not in line with the long-term trend.

Figure IV-1

Global Trade of Nonwovens

2010-2020 (in 1,000 Tonnes)



Sources: National Statistical Institutes, 2021

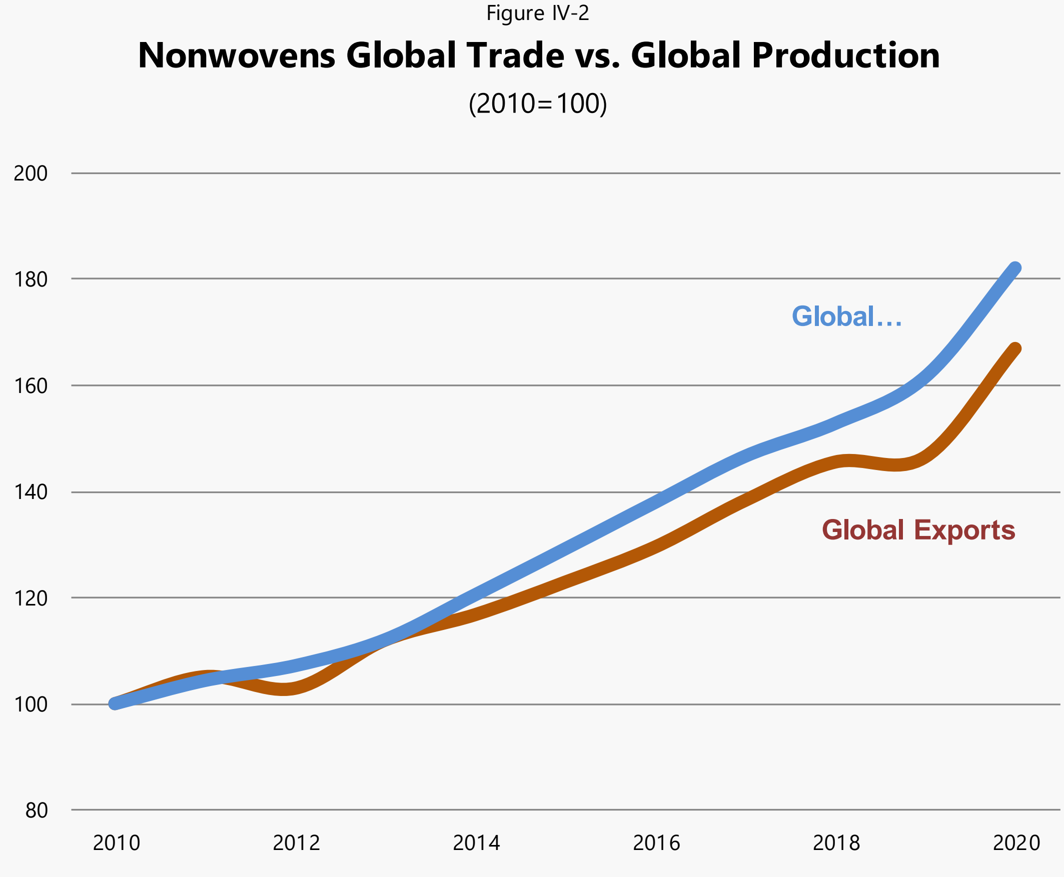
Opposite drivers (such as successive virus waves/lockdowns, re-localization of the production of finished products, protectionist measures vs. free trade agreements) make it difficult to draw conclusions about possible impacts on trade flows. However, the record level of world trade reached in 2020 can hardly be considered the new normal. Additionally, more long-term projects which ultimately aim to increase trade between regions (like the Chinese New Silk Road) have also increased the need for infrastructures and consequently, at least temporary, the demand for nonwovens. Therefore, despite the complexity of the trade links between countries on a worldwide basis, it is crucial to monitor these flows.

In ten years, the big picture of the worldwide trade of nonwovens has changed quite significantly. The evolution of nonwoven exports in both volumes and value has been impressive. In 2020—taking into account trade flows between the 27 countries of the European Union—more than 4.4 million tonnes of nonwovens, valued at around €14,500/US$16,500 million were exchanged worldwide. Calculation on the same basis for

2010 showed an approximate 2.6 million tonnes valued at €8,500/US$11,400 million. This evolution is by definition linked to the expansion of production capacities worldwide, but also to the unusual consumers demand we experienced in 2020.

The figure below (Figure IV-2) shows the relationship between global production and global exports with both indexed at 100 in 2010.

Figure IV-2



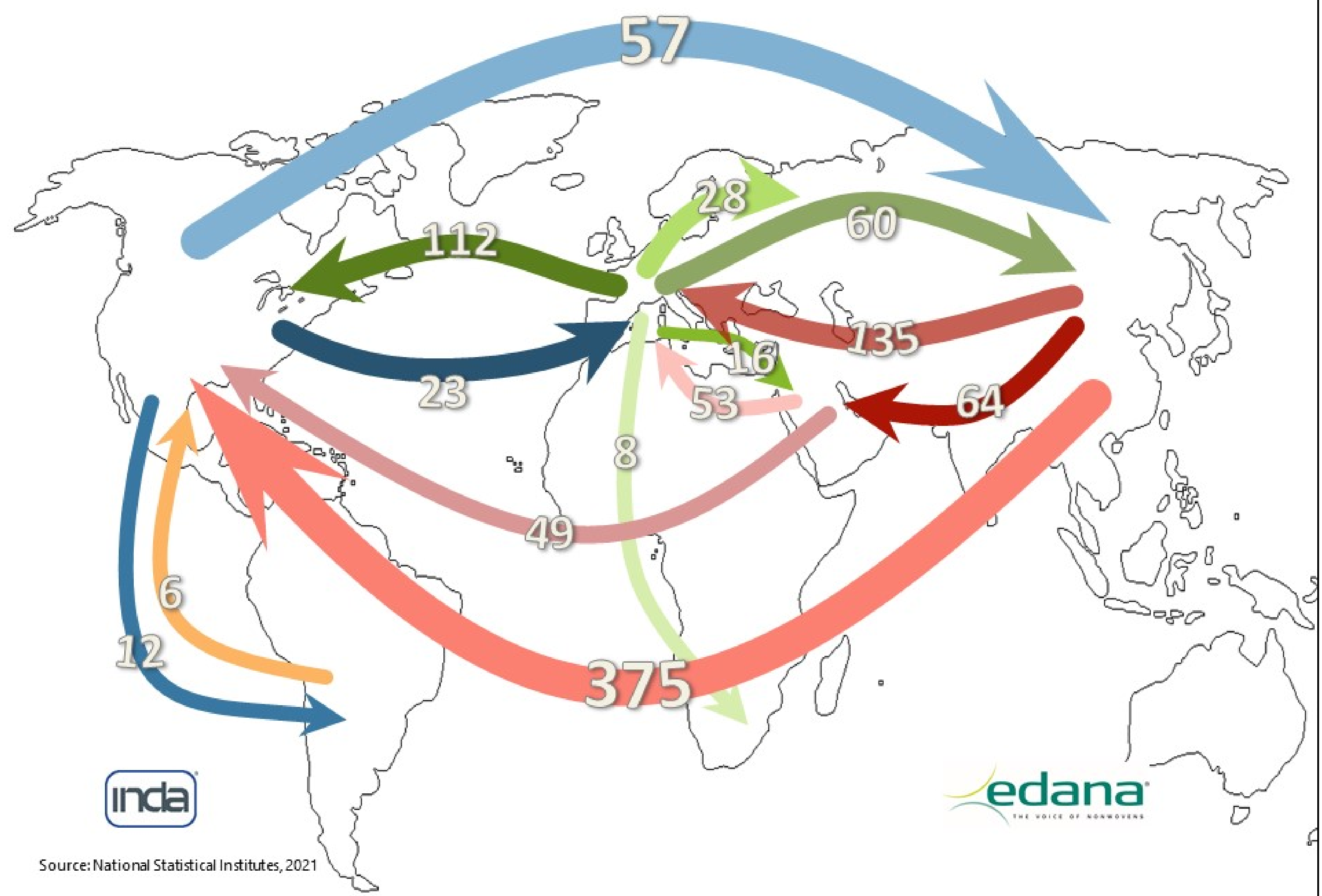
Sources: National Statistical Institute, 2021 & EDANA/INDA

The worldwide map (Figure IV-3) shows the 2020 big picture of the trade flows in tonnage between the main regions: European Union (EU27 countries), North America (USA, Canada, and Mexico), Asia (China and other Asian countries), Middle East, South America and South Africa.

In 2020, China alone exported nearly 1.4 million tonnes of nonwovens, four times more than in 2010. The European Union, and its 27 Members States, exported roughly one third of Chinese exports. However, EU27 has never exported and imported more than in 2020. U.S. exports slightly increased, but U.S. imports jumped by 66.9% compared to their

2019 level. In both the EU27 and the U.S., imports grew faster than exports over the last couple of years, causing a deterioration of their respective trade balances.

Figure IV-3
International Trade Flows of Nonwovens Roll Goods in 2020
('000 tonnes)



Source: National Statistical Institutes, 2021

The top twenty list of exporting countries (Table IV-2) also included Turkey (248,000 tonnes), Taiwan (114,000 tonnes), Israel (100,000 tonnes), Thailand (89,400 tonnes), Malaysia (82,000 tonnes), India (71,100 tonnes), and South Korea (69,000 tonnes). Development in exports from Saudi Arabia, Russia and Egypt must also be highlighted.

Table IV-2

Major Global Exporters of Nonwovens in 2020

In Order by Tonnage Exported

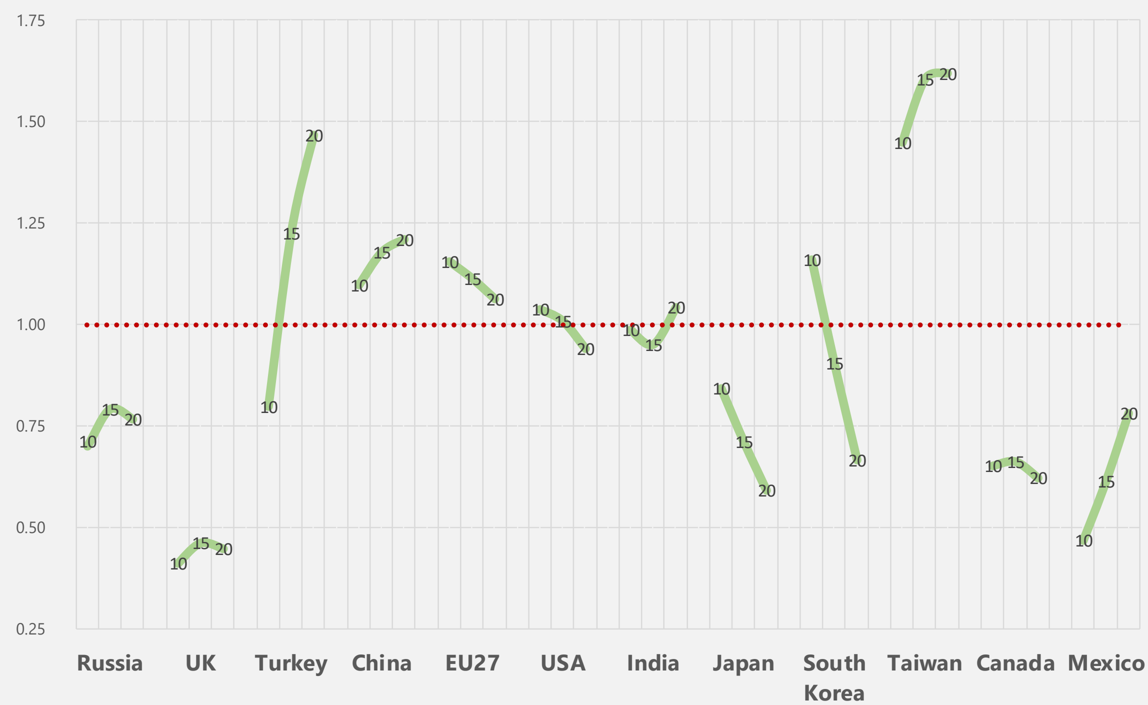
Countries	1,000 Tonnes	20 vs. 10	Mio €	20 vs. 10
China	1,388.8	272%	4,383.1	433%
EU27	484.2	27%	2,157.3	47%
U.S.	294.5	-5%	1,666.1	39%
Turkey	248.1	442%	607.1	456%
Taiwan	114.3	56%	414.0	90%
Israel	100.2	55%	287.8	136%
Thailand	89.4	128%	236.0	162%
Malaysia	82.0	132%	162.9	118%
India	71.1	290%	151.1	315%
South Korea	69.0	-14%	304.3	-3%
Saudi Arabia	63.4	65%	137.1	105%
Japan	62.1	25%	675.2	35%
Egypt	47.2	3,644%	93.9	5,059%
Belarus	37.4	74%	62.2	78%
Russia	34.6	414%	73.5	387%
Brazil	31.5	-51%	85.7	-42%
Indonesia	31.3	153%	79.6	188%
Canada	29.7	105%	128.0	110%
UK	25.4	-3%	196.6	52%
Mexico	22.8	-80%	106.8	67%

Source: National Statistical Institutes, 2021

As described in Chapter II "Nonwoven Supply," the increase of nonwovens production has been quite important in some countries/regions over the period 2010-2020 and, with the help of the trade data, it is interesting to compare the local production with the evolution of the local consumption, direct and undirect through the manufacture of converted products.

Figure IV-4

Nonwovens Production vs. Consumption (2010-2015-2020)



Sources: EDANA/INDA 2021

Figure IV-4 shows the evolution of the ratio "Production/Consumption," on the Y-axis, in 2010, 2015 and 2020. A value higher than 1 means that the country produced more than it locally consumed and exported the rest of its production. If the value is lower than 1, the country relies on imports to fulfill its own local demand. For instance, the Chinese ratio grew from 1.10 in 2010 to 1.21 in 2020, which means that the Chinese production was 10% higher than the local consumption in 2010 and 21% higher in 2020.

Obviously, this graph can only give an overall picture and cannot go into detail. A country may need a specific nonwoven produced only, or in sufficient volumes, abroad, but at the same time appear to be a net exporter of nonwovens. Anyhow, this graph provides interesting findings.

Countries like Russia, the United Kingdom or Canada were dependent on imports, with similar values in 2010, 2015 and 2020, despite an important increase of the local production in the case of Russia. In 2020, in countries like China, Taiwan, Mexico, India or Turkey, the export market increased compared to the 2010 situation. Looking at Turkey, the local production, which was 20% below the level of the local consumption in

2010, was 47% higher ten years after. In EU27, U.S., Japan and South Korea, the need for an external supply has been increasing over the last decade.

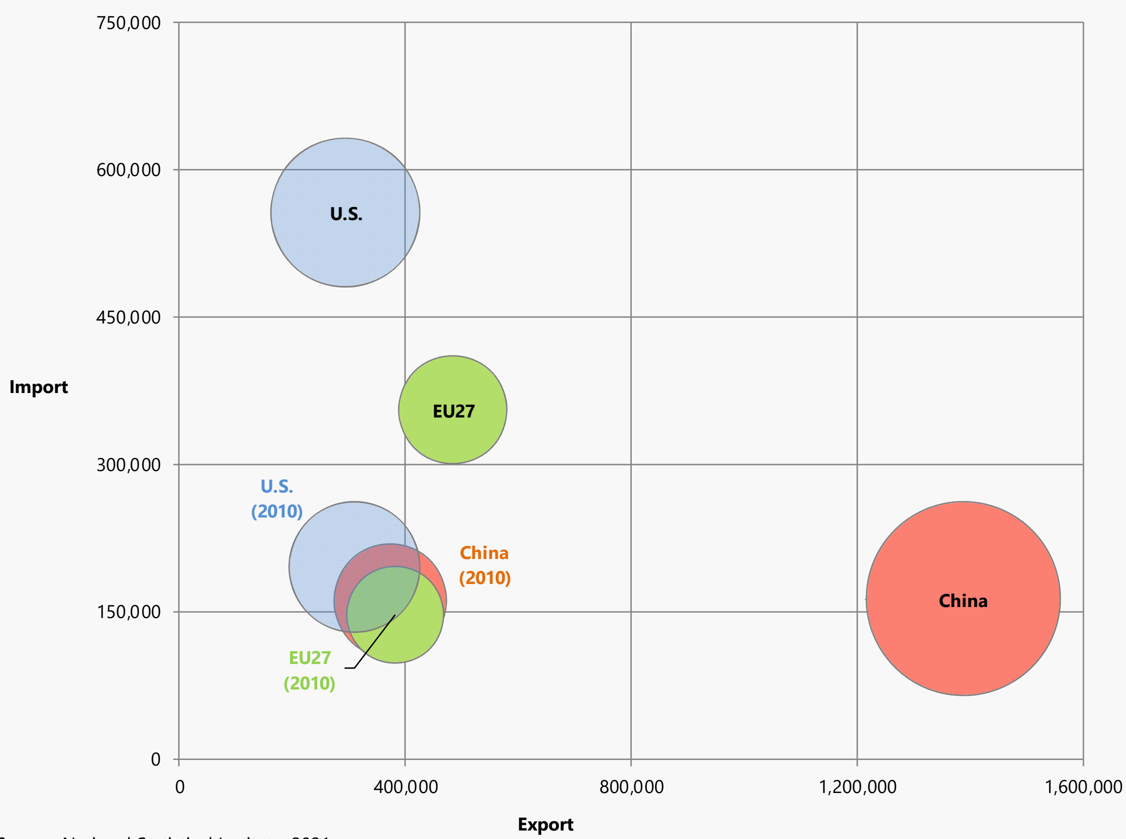
Three Main Suppliers

The percentages of growth recorded by the major countries producing nonwovens in the world offers proof of the major development and importance of the trade of nonwoven roll goods.

Figure IV-5

Leading Economies of Nonwovens Trade

Yearly Export and Import, 2010-2020 (in tonnes)



Source: National Statistical Institute, 2021

Looking at the 2020 list of major global exporters of nonwoven, it is easy to deduce that the regions with the larger capacities of production—China, U.S., and EU27—are the main exporters of nonwovens globally too. It is also important to underline that U.S. and the European Union are still the main importers, while Chinese imports have been almost flat over the last decade. Figure IV-5 provides a view of the exports and imports volumes of the three regions in both 2010 and 2020 with the size of the bubble representing their domestic production in 2020.

European Union

The United Kingdom officially left the European Union on 1 January 2021. Therefore, series of trade data had to be adjusted accordingly from 28 to 27 Member States and EU data hereafter do not include UK trade flows of roll goods anymore. The United Kingdom specific trends are now isolated.

In 2020, the European Union (EU27) showed a reduced but still positive trade balance with the rest of the world, when the overall EU textile industry showed a deficit of its trade balance.

Between 2010 and 2019, EU27 exports of nonwovens continuously increased (+2.0% annual average growth rate). In contrast, imports of roll goods recorded higher growth rates over the same period: +9.1% in average .

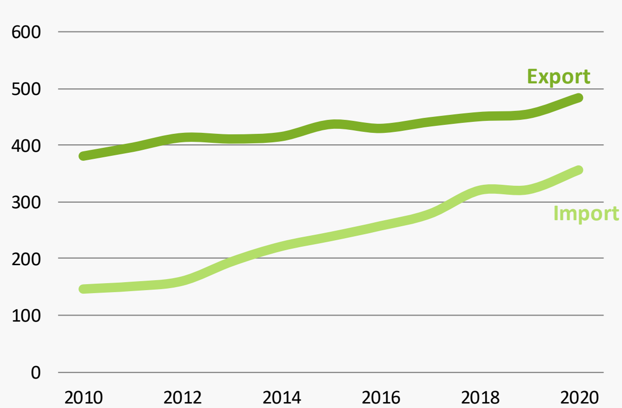
In 2020, EU27 exports of nonwovens to the rest of the world increased by 6.3% in volume compared to 2019, but imports increased faster again by 10.6%, meaning the EU27 trade balance actually decreased by 4.1% in one year. Over the last decade, EU27 exports grew by 27.1% and imports by 142.4% (Figure IV-6 and Table IV-3).

Figure IV-6

European Union, Yearly Export and Import of Nonwovens

2010-2020 (in 1,000 Tonnes)

Decline of the EU Trade Balance in volumes ...



Source: Eurostat, 2021

Table IV-3

Trade Flows by Type of Products

2020 (in Million Euros)

... But still highly positive in value

	Export	Import
Spunmelt materials:	**1,589.5**	**1,027.0**
Less than 25 gsm	217.6	246.6
25 to 70 gsm	546.8	396.6
70 to 150 gsm	423.0	186.8
More than 150 gsm	402.1	196.9
Fiber-based materials:	**567.8**	**410.0**
Less than 25 gsm	26.1	47.7
25 to 70 gsm	229.0	194.2
70 to 150 gsm	120.6	61.5
More than 150 gsm	192.1	106.5
Total	**2,157.3**	**1,436.9**

The trade between member countries within the European Union, the so called intra-trade, has also been constantly growing over the last decade. While 775,740 tonnes of nonwovens (valued at 2,719 million euros) were traded between EU27 countries in 2010, it amounted to 1,088,500 tonnes (3,967 million euros) ten years later. Compared to the previous year, the volumes exchanged increased by 3.6%, but the euro value decreased by 2.0%.

EU27 Trade Flows by Region

The following figures display the relative importance of each region for EU27 trade in 2020, in both exports (Figure IV-7) and imports (Figure IV-8).

The European countries who are not EU members are globalized in "Other Europe," - in light green – and includes neighboring countries like the United Kingdom, Russia, Switzerland, Norway and Turkey. Other European countries were still the main partner countries of the European Union in 2020: 44.2% of the exports and 36.8% of the imports of nonwovens.

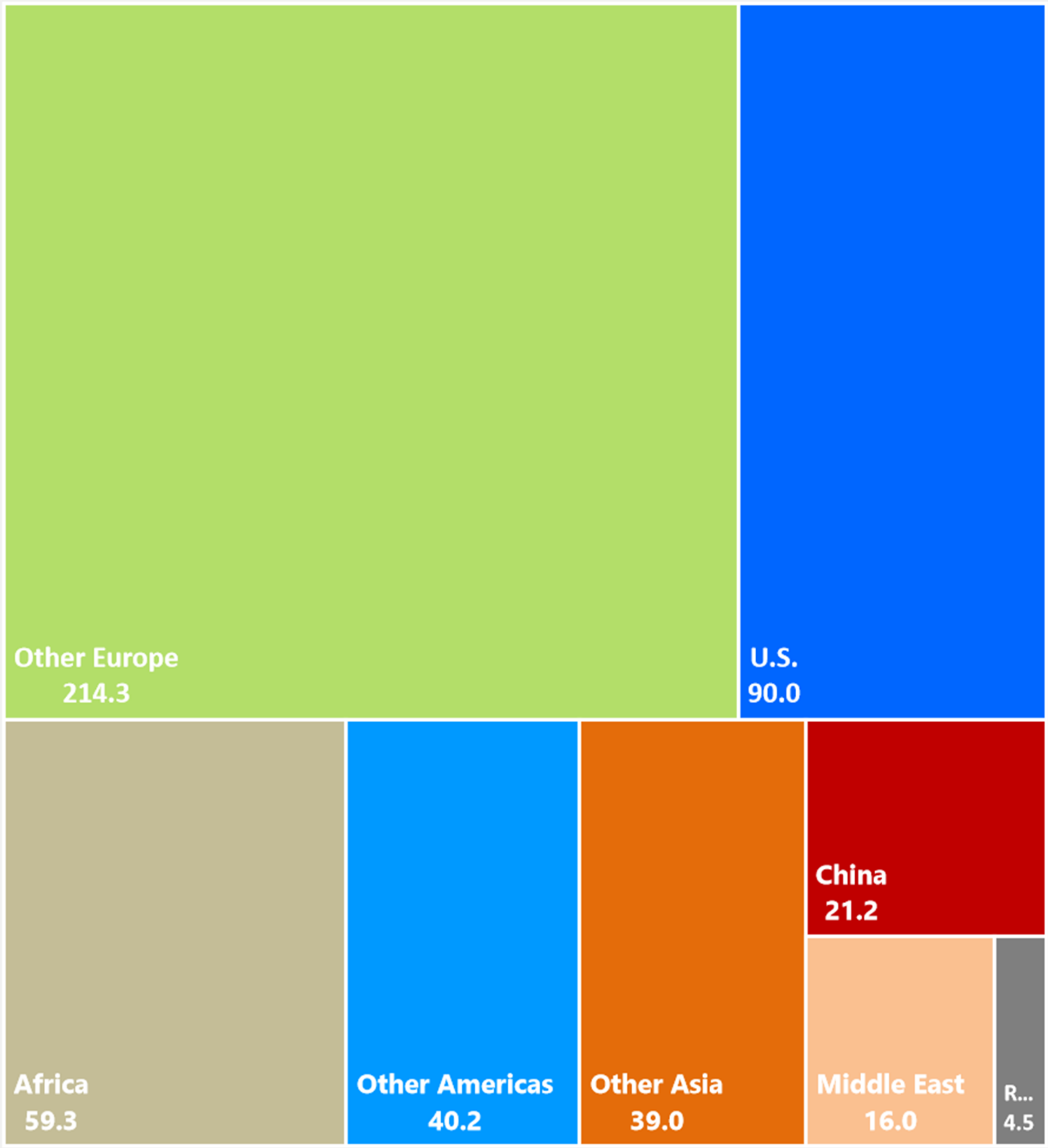
In 2020, Chinese nonwovens represented nearly 32% of EU27 imports. The flow of Chinese products entering into the EU has multiplied 3.5 times in one decade to reach 113,100 tonnes, but exports to China were at the same level as ten years before. Americas are the second most important destinations of roll goods leaving the EU with 90,000 tonnes to U.S. and 40,200 tonnes to "Other Americas" in 2020. African countries completed the top three main regions in exports.

While 2010 imports from Middle East countries and from the United States were both at around 27,700 tonnes, the situation was quite different ten years later. Indeed, U.S. deliveries to EU were down to 21,800 tonnes and the ones from the Middle East nearly doubled at 52,600 tonnes. Trade flows from other Europe countries, China and Middle East countries represented all together 83.3% of EU total imports.

Figure IV-7

European Union - 2020 Export - Main Trading Partner Regions

(in 1,000 Tonnes)

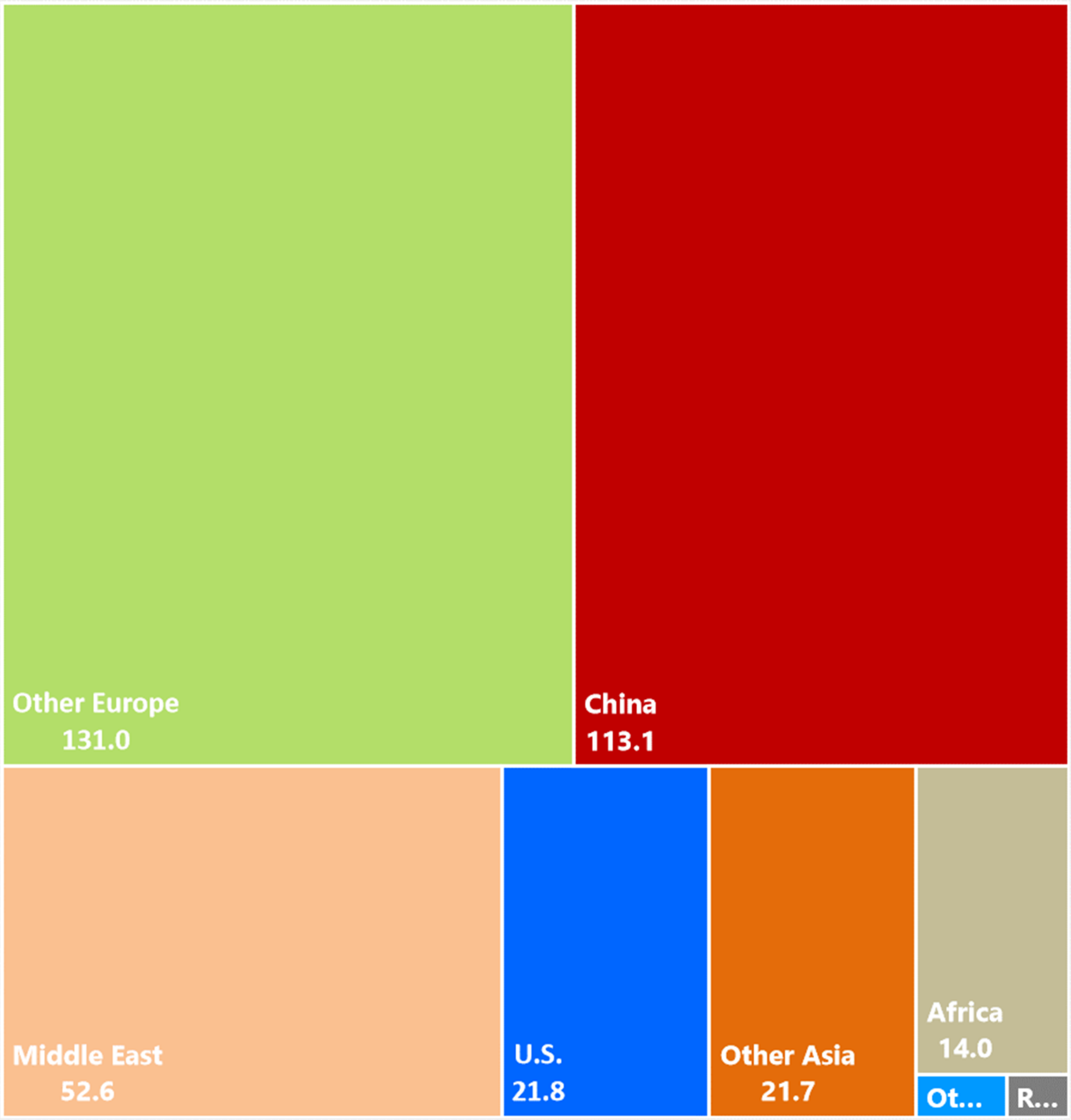


Source: EDANA, 2021

Figure IV-8

European Union - 2020 Import - Main Trading Partner Regions

(in 1,000 Tonnes)



Source: EDANA, 2021

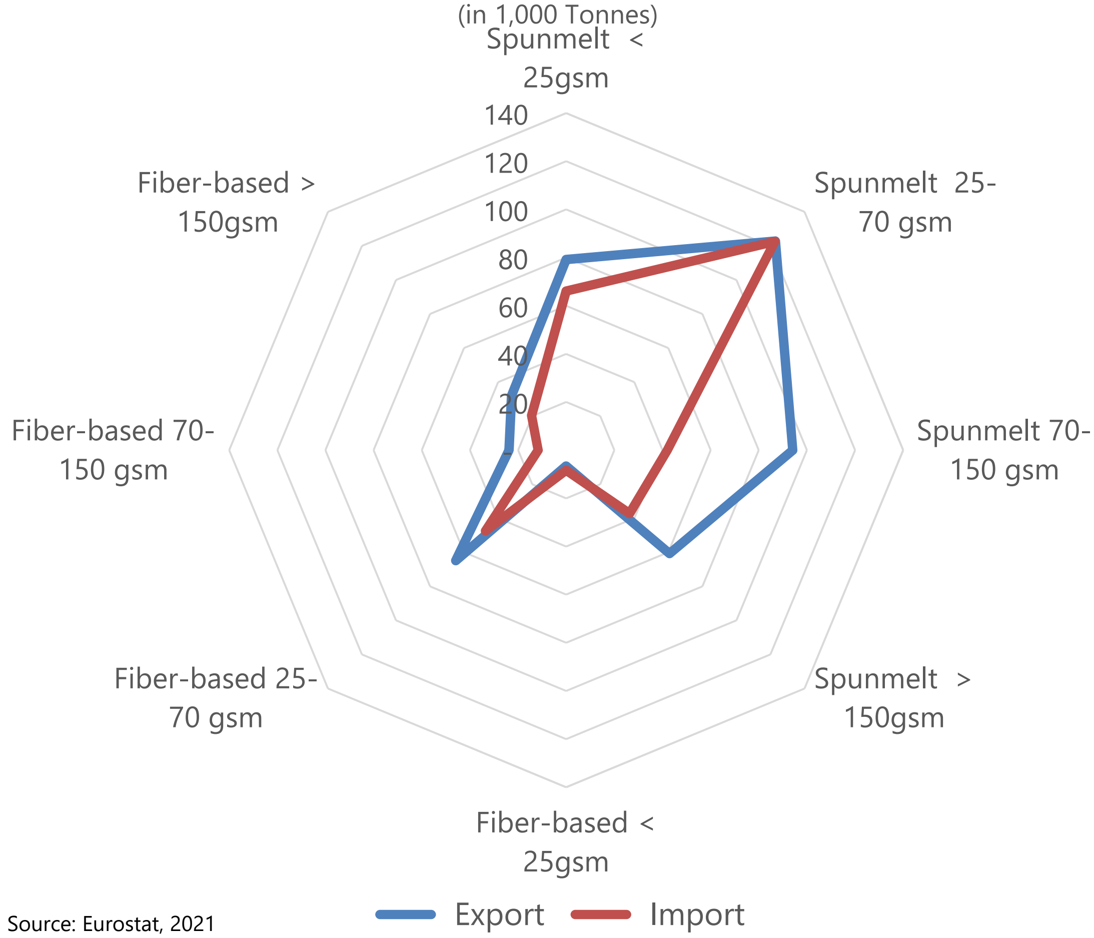
EU27 Trade Flows by Type of Products

Looking at the segmentation by type and by grammage proposed by the official nomenclature, we can go deeper into the analysis of the materials coming in and going out of the European Union in 2020 (Figure IV-9).

Figure IV-9

2020 European Union Trade Flows by Type of Products

(in 1,000 Tonnes)



Source: Eurostat, 2021

Even if this were to be analyzed country by country, in total, a majority of EU trade of roll goods were spunlaid products. Whatever the type of product, EU27 exported more tonnes than it imported, except in fiber-based nonwovens below 25 gsm where EU27 had a slightly negative trade balance.

Spunmelt materials accounted for 73.7% of all EU exports of nonwovens, and 41.7% were spunmelt below 70 gsm. The same analysis by type of products revealed that only one fourth of imported roll goods came from staple fiber materials in 2020. The roll goods coming into EU27 countries were mainly low- weight products as 68.7 of the import were products of less than 70 gsm. We also noticed the increase of heavy products (more than 150 gsm) imports, from 24,400 tonnes in 2010 to 57,600 tonnes in 2020.

United States

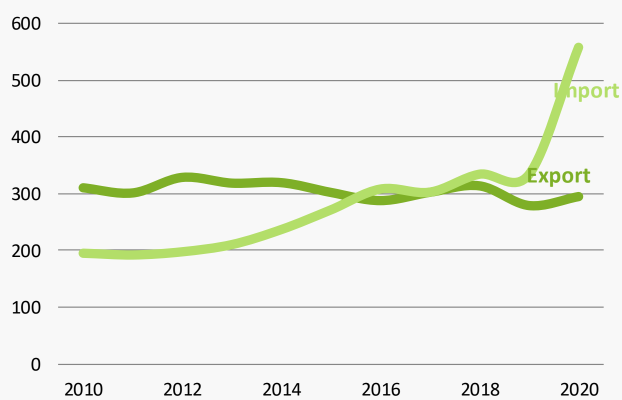
Over time, exports from the United States have exceeded imports, but as of 2012 the U.S. net trade balance has been decreasing to be negative since 2016. Until 2019, U.S. total exports and imports were similar in volumes. A year later, both increased again, but a lot faster in imports (+66.9%) than in exports (+5.6%). The United States nonwovens market is influenced by both inter-region (exports mainly to other American countries) and intra-region (imports mainly from overseas countries) trade of nonwoven rolled goods.

Figure IV-10

United States, Yearly Export and Import of Nonwovens

2010-2020 (in 1,000 Tonnes)

USA trade balance highly negative in volumes ...



Source: National Statistical Institute, 2021

Table IV-4

Trade Flows by Type of Products

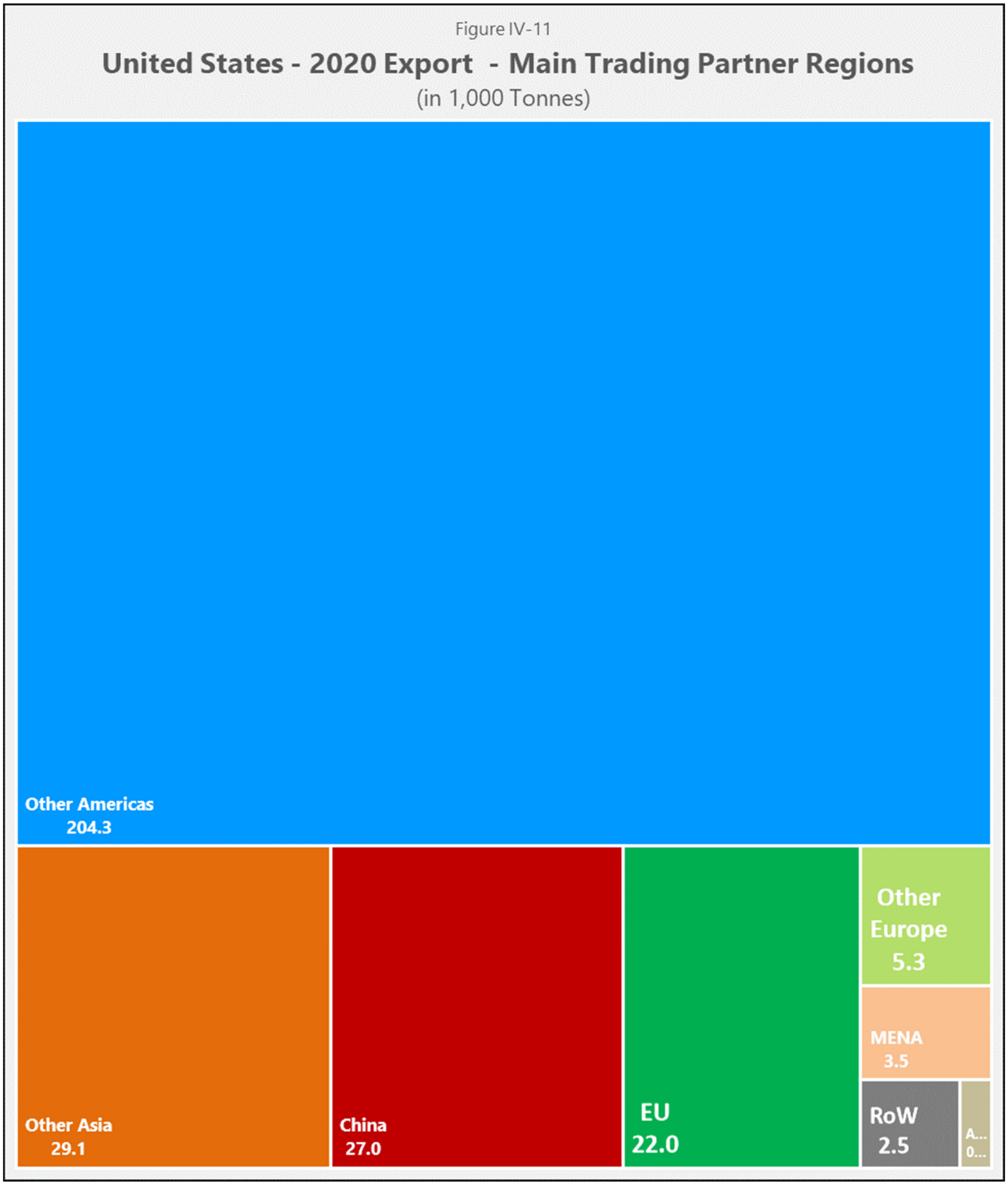
2020 (in Million Euros)

... But closed to zero in value

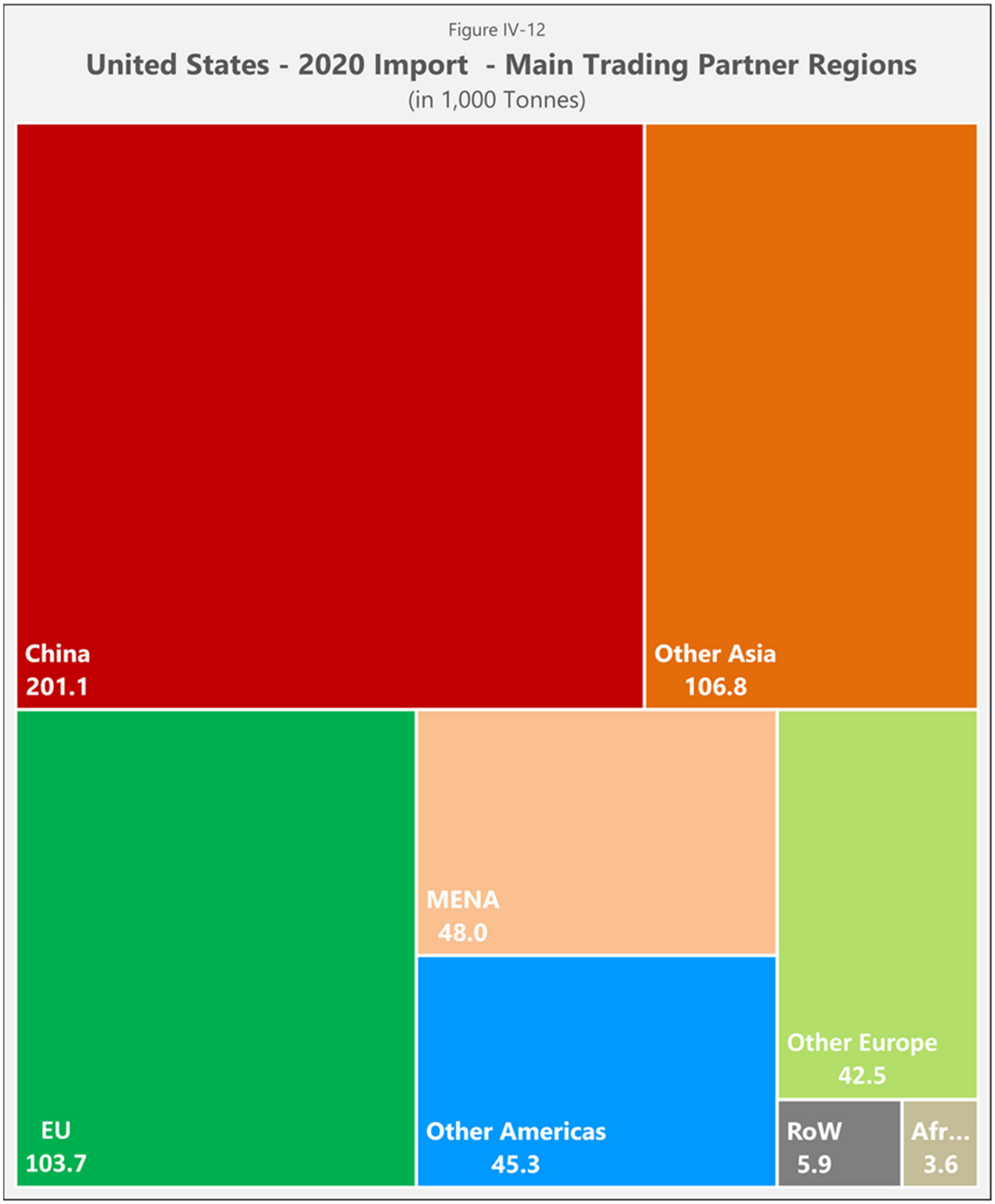
	Export	Import
Spunmelt materials:	**1,281.5**	**1,033.2**
Less than 25 gsm	173.7	161.3
25 to 70 gsm	584.9	473.0
70 to 150 gsm	299.8	190.3
More than 150 gsm	223.1	208.6
Fiber-based materials:	**384.6**	**657.1**
Less than 25 gsm	12.0	19.2
25 to 70 gsm	177.3	381.7
70 to 150 gsm	104.0	97.6
More than 150 gsm	91.4	158.6
Total	**1,666.1**	**1,690.3**

In 2020, the pandemic highly impacted the need for nonwovens materials, and overseas imports took a major and erratic jump, increasing 66.9% compared to the 2019 level. As described in Figure IV-13, important imports volumes were recorded in spunmelt below 25 gsm (+177%), spunmelt between 25 gsm and 70 gsm (+50%) and fiber-based materials between 25 gsm and 70 gsm (+134%).

United States Trade Flows by Region



Source: EDANA, 2021



Source: EDANA, 2021

In 2020, half (55.3%) of U.S. imports came from Asian countries. Within the Asian countries, trade development with China should be highlighted here as well. China is by far the largest supplier to the United States. In 2010, U.S. trade balance with China was still positive: 38,600 tonnes exports and 43,700 tonnes imports. In 2020, the situation was significantly different as exports went down to 27,000 tonnes and imports up to 201,000 tonnes (Figure IV-12). Chinese nonwovens represented 36.1% of U.S.'s total imports, but only 9.2% of its total exports.

Imports from the 27 European Union countries increased by 18.4% compared to 2019; it reached 103,700 tonnes in 2020.

Over the last ten years, the U.S. increased by 17.5% its sales to other countries in the Americas which represented together 69.4% of U.S. exports in 2020 (Figure IV-11). More than half (58.1%) of the U.S. total exports were sent to the North America region in 2020: 82,438 tonnes were delivered to Canada and 88,551 tonnes to Mexico. On the other hand, the U.S. has seen its exports to overseas countries decreasing; -21.3% to Asia, -48.2% to Europe. Asian countries received 56,100 tonnes in 2020 (it was 71,300 tonnes in 2010). U.S. deliveries to EU27 slightly increased last year (+0.9% compared to 2019), but were below the level reached 10 years before.

United States Trade Flows by Type of Products

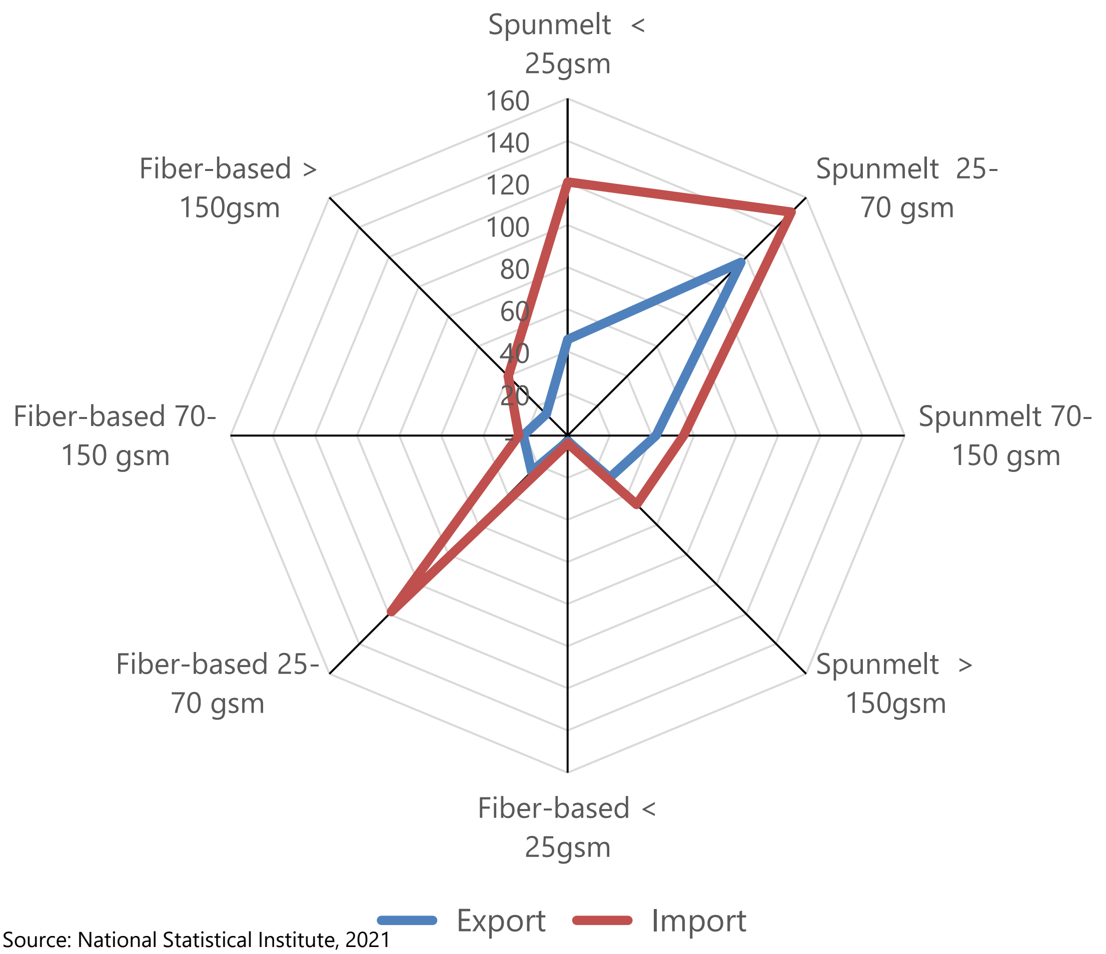
In 2020, for each sub-category of roll goods, the United States had a negative trade balance (Figure IV-13).

The gap between flows of materials going out and coming in to the U.S. was quite big in spunmelt below 25 gsm (- 75,000 tonnes), spunmelt between 25 and 70 gsm (- 34,000 tonnes) and fiber-based nonwovens between 25 and 70 gsm (- 94,000 tonnes).

Figure IV-13

2020 United States Trade Flows by Type of Products

(in 1,000 Tonnes)



Source: National Statistical Institute, 2021

China

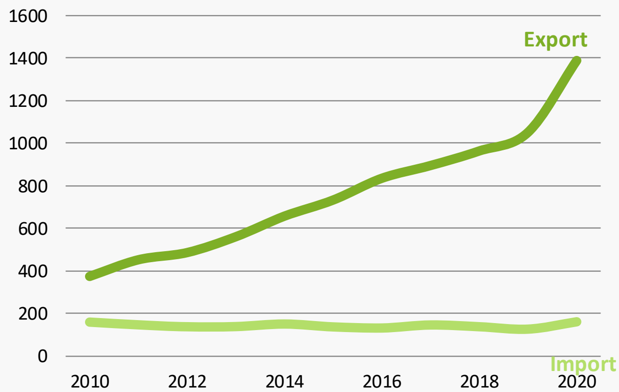
Chinese exports of nonwovens roll goods have continually grown since the beginning of the century. Since 2005, the Chinese trade balance in nonwovens with the rest of the world is positive. In 2010, only 373,300 tonnes—of which 168,800 of those tonnes remained in Asia—were exported out of China. In 2011, China became the leading global exporter of nonwoven roll goods. In just ten years, China increased its exports by 1,000,000 tonnes (Figure IV-14).

Figure IV-14

China, Yearly Export and Import of Nonwovens

2010-2020 (in 1,000 Tonnes)

Chinese exports booming ...



Source: National Statistical Institute, 2021

Table IV-5

Trade Flows by Type of Products

2020 (in Million Euros)

... and a trade balance over 3 billion euros

	Export	Import
Spunmelt materials:	**1,912.2**	**573.1**
Less than 25 gsm	619.5	88.8
25 to 70 gsm	886.4	282.4
70 to 150 gsm	212.5	122.3
More than 150 gsm	193.7	79.6
Fiber-based materials:	**2,471.0**	**413.4**
Less than 25 gsm	468.5	58.9
25 to 70 gsm	1,265.3	146.7
70 to 150 gsm	304.0	71.7
More than 150 gsm	433.2	136.0
Total	**4,383.1**	**986.5**

Chinese Trade Flows by Region

In 2010, both in exports and imports, Chinese trade flows were focused on the rest of Asia, which represented 45.2% of Chinese exports and 49.2% of imports. A decade later, Asian countries are still their most important trade partners (53.5% of exports and 53.8% of imports).

Of the 1,388,600 tonnes of Chinese materials exported in 2020, 742,700 were distributed throughout the other Asian countries (Figure IV-15); the most supplied countries were South Korea (182,000 tonnes), Japan (121,700 tonnes), Vietnam (120,100 tonnes), Indonesia (52,200 tonnes) and Cambodia (38,200 tonnes).

Nevertheless, China has also intensified its trade of nonwovens with the rest of the world in volumes. Outside Asia, the European Union (142,200 tonnes) and the United States (132,300 tonnes) were important destinations for Chinese material. China exported more to Central and South American countries than to the U.S. in 2020. Exports to the other regions (Africa, other Europe, Middle East and Rest of the world) together accounted for only 16.9% of the total.

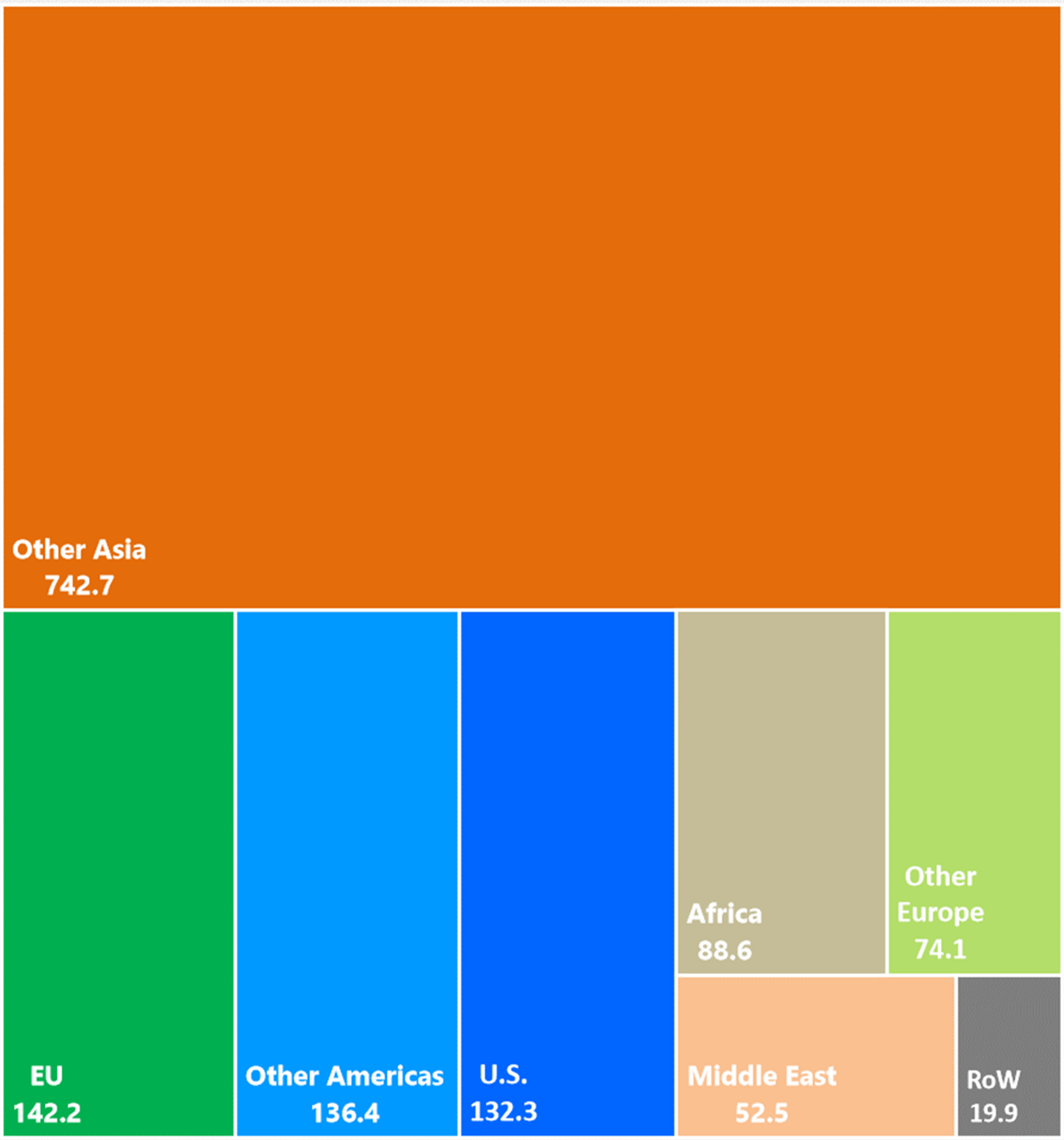
Chinese yearly imports have remained level over the past decade, despite the exponential growth of the local production. Nonwovens roll goods which came into China (Figure IV-16) were mainly from other Asian countries, the EU and the United States, although

Chinese imports from the United States have significantly decreased from 47,200 tonnes in 2010 to 27,550 tonnes in 2020.

Figure IV-15

China - 2020 Export - Main Trading Partner Regions

(in 1,000 Tonnes)

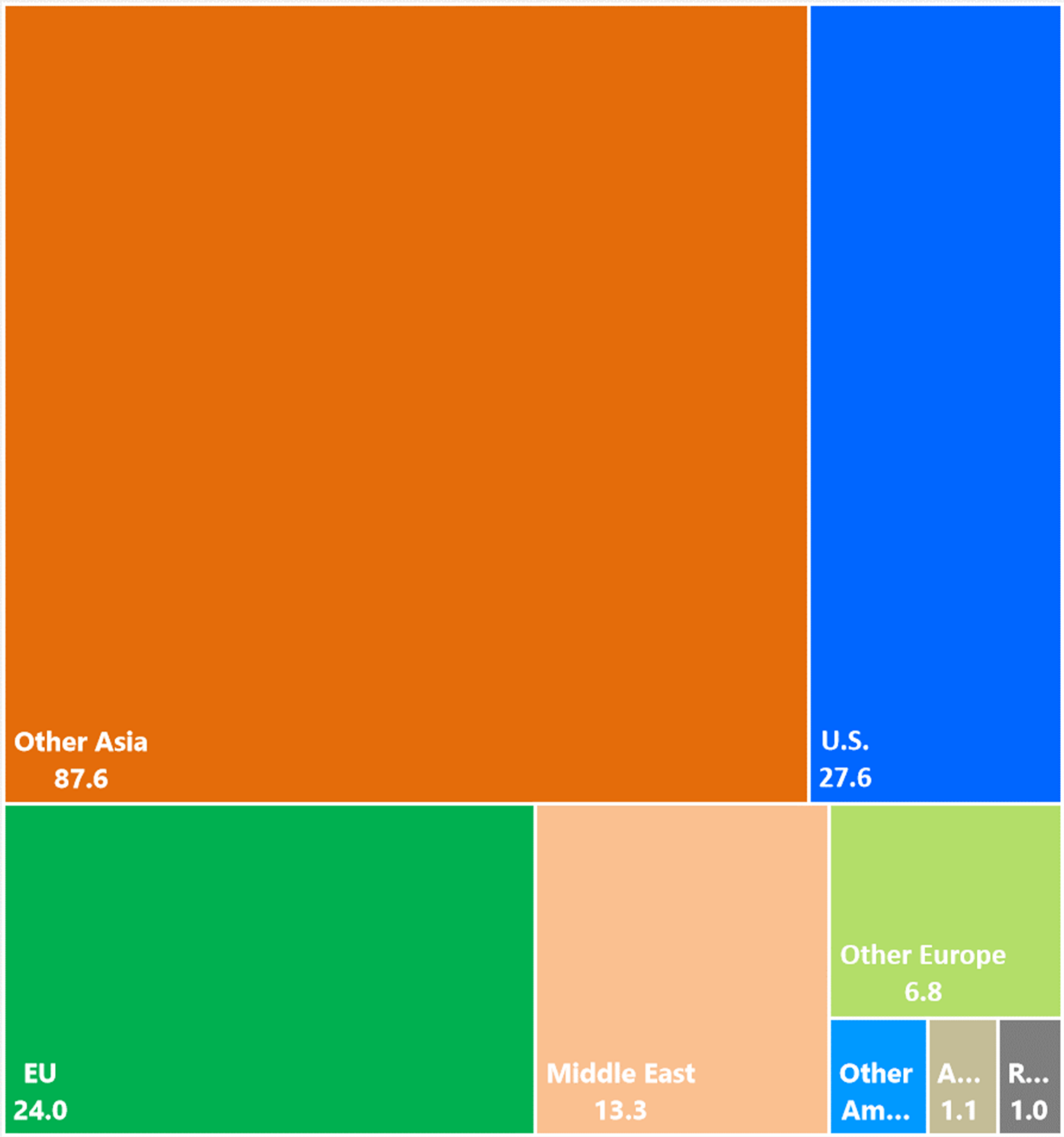


Source: EDANA, 2021

Figure IV-16

China - 2020 Import - Main Trading Partner Regions

(in 1,000 Tonnes)



Source: EDANA, 2021

Chinese Trade Flows by Type of Products

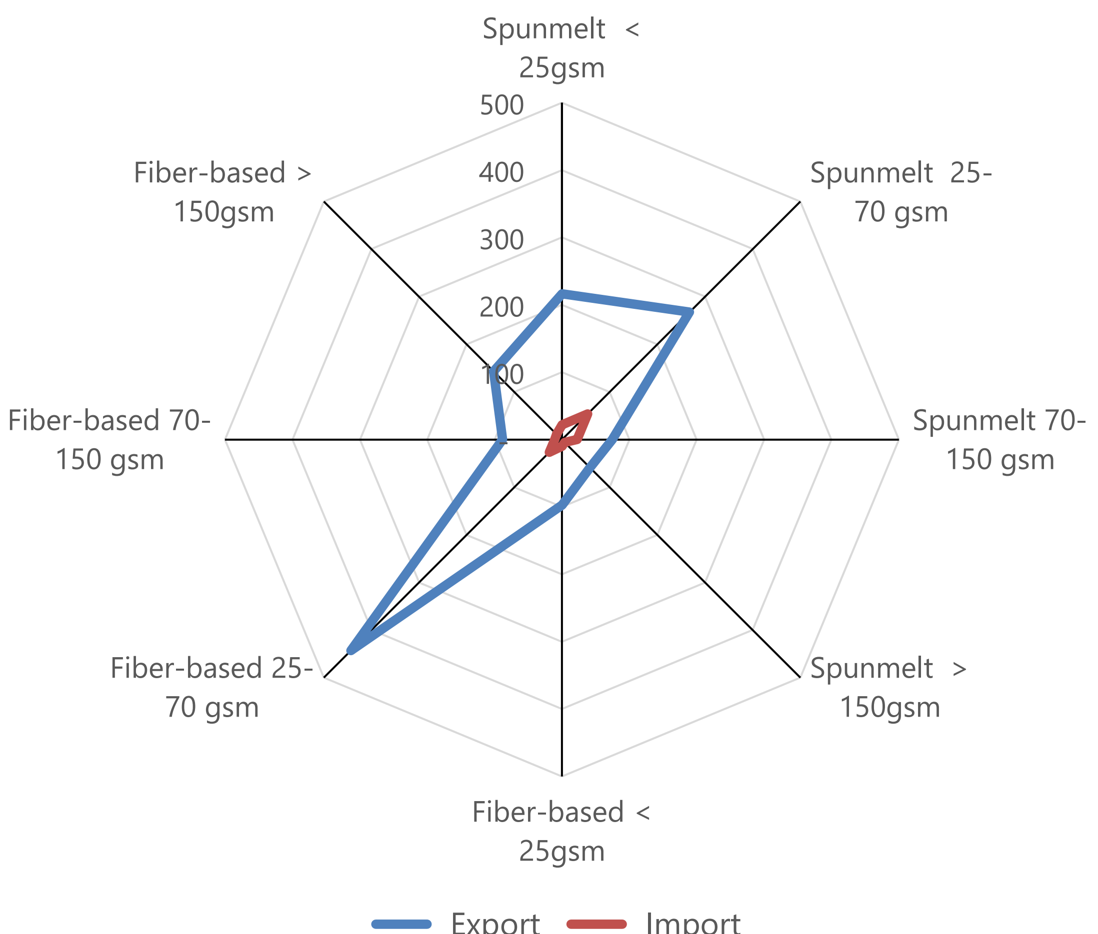
Last year, the overall Chinese trade balance was positive (Figure IV-14), but a deeper analysis by the type of product shows that China exported more roll goods than imported, in volumes and in value, whatever the product weight classification (Table IV-5 and Figure IV-14).

As described in the figure below (Figure IV-17), 31.9% of the Chinese exports came from fiber-based nonwovens between 25 and 70 gsm, while 63.8% of the imports were from spunmelt materials.

Figure IV-17

2020 China Trade Flows by Type of Products

(in 1,000 Tonnes)



Source: National Statistical Institute, 2021

United Kingdom

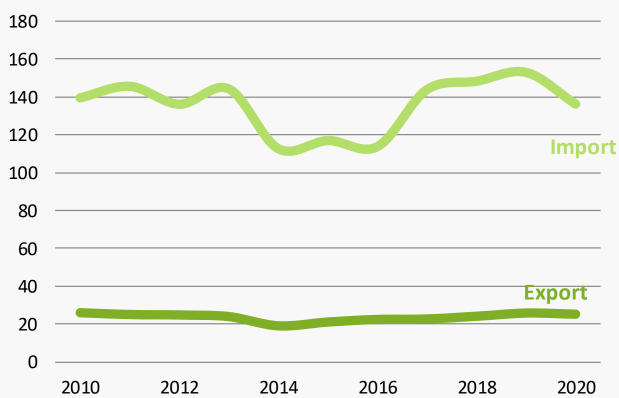
Brexit also impacted trade statistics and roll goods trade flows between the United Kingdom and the rest of the world, and are, by definition, not included in the European Union figures anymore. Despite its 19th place in the top twenty exporting countries (Table IV-2), the United Kingdom relied on imports to fill in its local demand, and during the period 2010-2020, the UK trade balance was highly negative every year (Figure IV-18 and Table IV-6).

Figure IV-18

United Kingdom, Yearly Export and Import of Nonwovens

2010-2020 (in 1,000 Tonnes)

Negative Trade Balance in volumes...



Sources: National Statistical Institute/Eurostat, 2021

Table IV-6

Trade Flows by Type of Products

2020 (in Million Euros)

... and in value too.

	Export	Import
Spunmelt materials:	**158.4**	**325.1**
Less than 25 gsm	39.2	73.1
25 to 70 gsm	42.7	144.0
70 to 150 gsm	54.2	79.6
More than 150 gsm	22.3	28.5
Fiber-based materials:	**38.2**	**119.1**
Less than 25 gsm	1.2	5.5
25 to 70 gsm	5.9	72.6
70 to 150 gsm	9.1	18.0
More than 150 gsm	22.1	23.0
Total	**196.6**	**444.2**

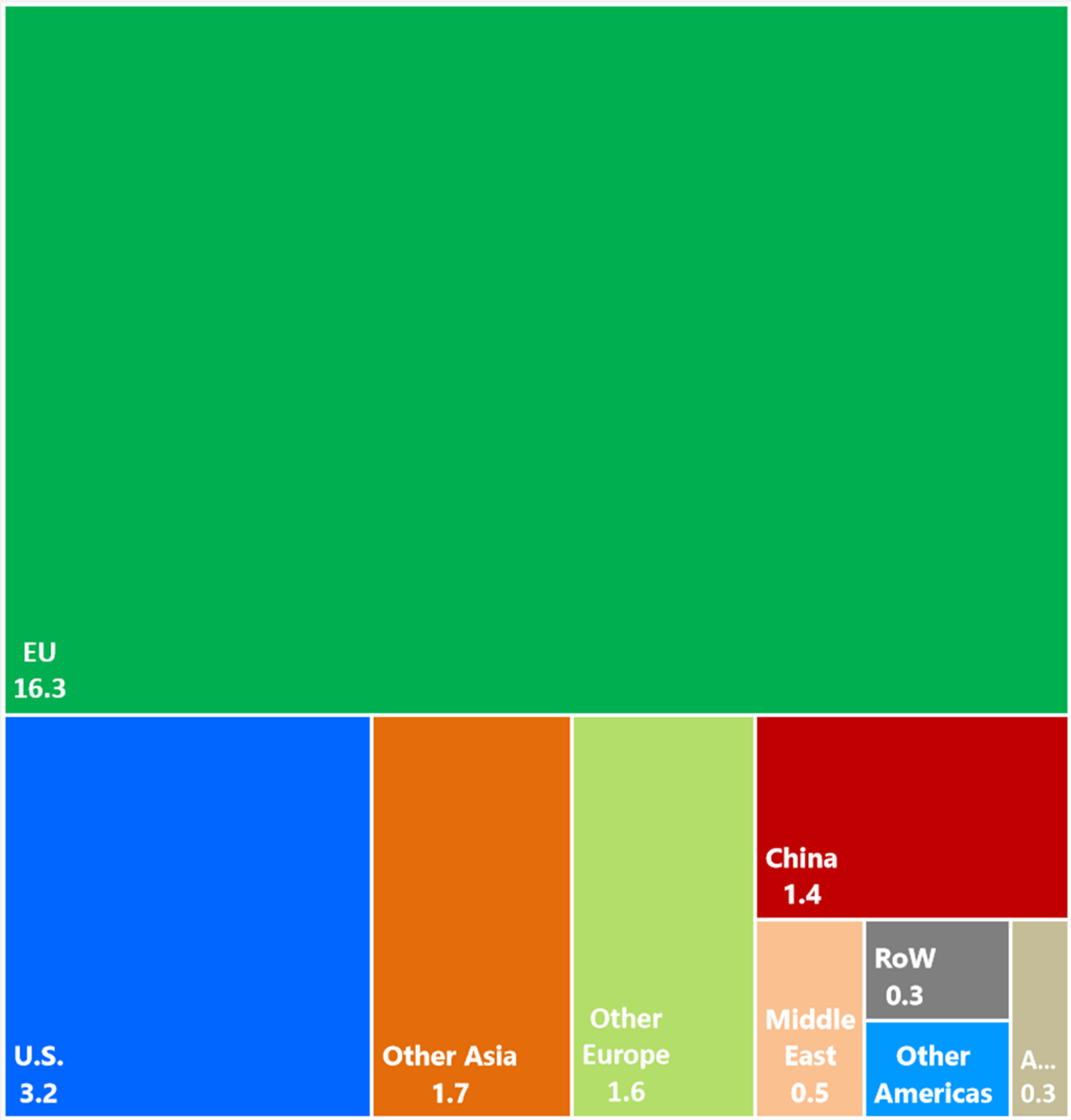
UK Trade Flows by Region

In 2020, UK main trading partner countries were the European countries, EU27 and others, in both exports (Figure IV-19) and imports (Figure IV-20). The European Union alone accounted for 63.9% of UK exports and for 50.2% of UK imports.

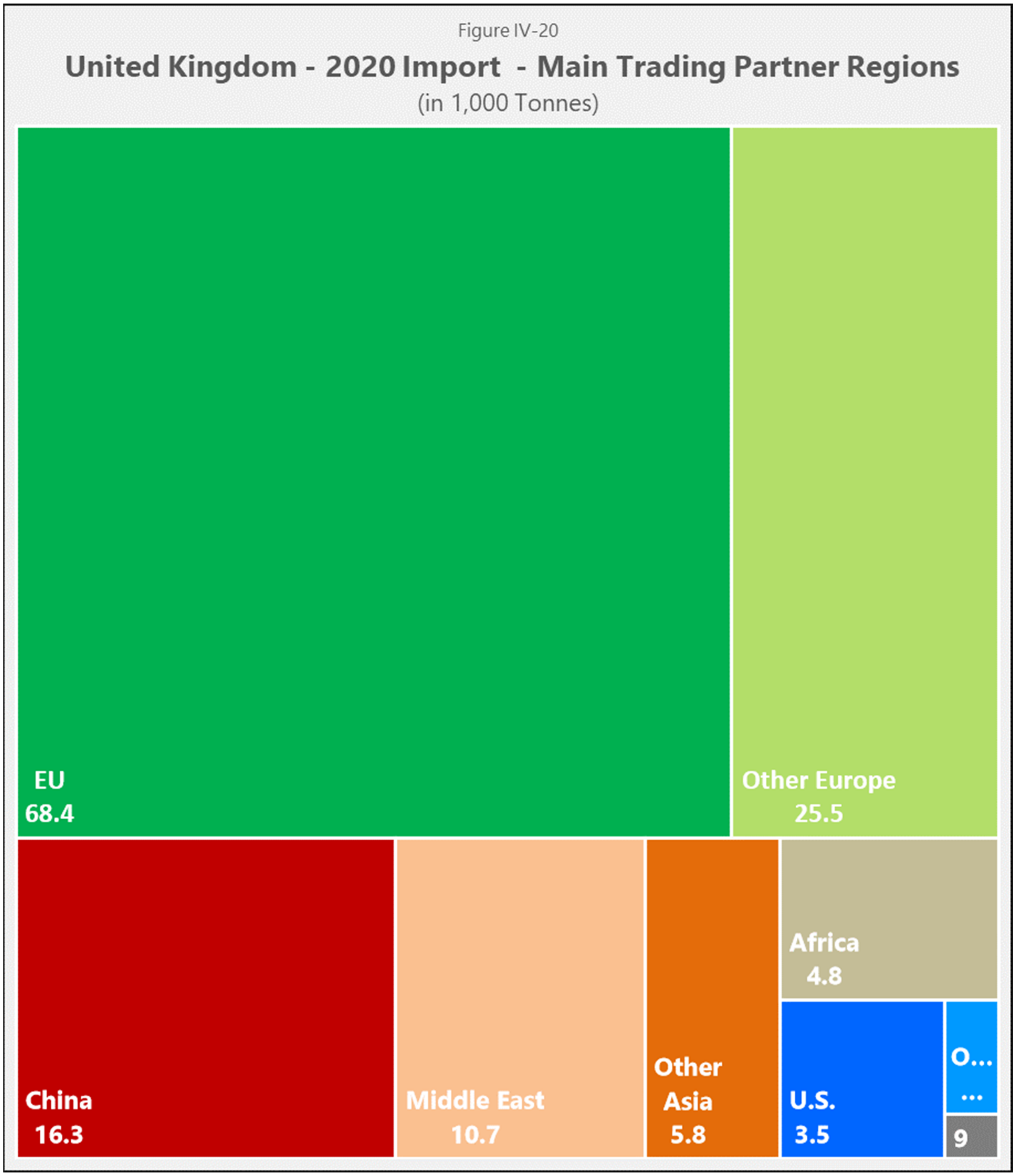
Figure IV-19

United Kingdom - 2020 Export - Main Trading Partner Regions

(in 1,000 Tonnes)



Source: EDANA, 2021

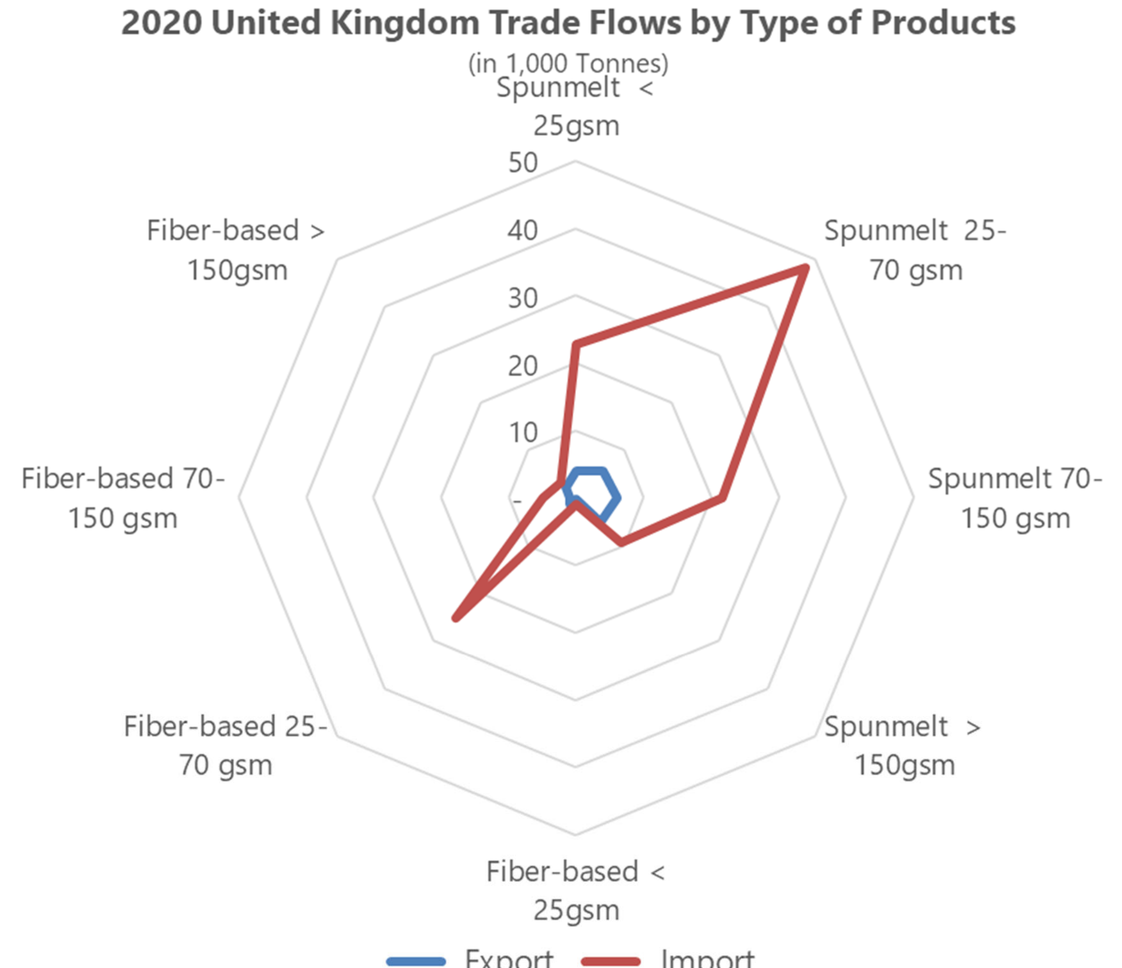


Source: EDANA, 2021

UK Trade Flows by Type of Products

For each sub-category of the HS nomenclature, the UK had a deficit trade balance in 2020. Most of the imports were in nonwovens between 25 and 70 gsm (Figure IV-21).

Figure IV-21



Sources: National Statistical Institute/Eurostat, 2021

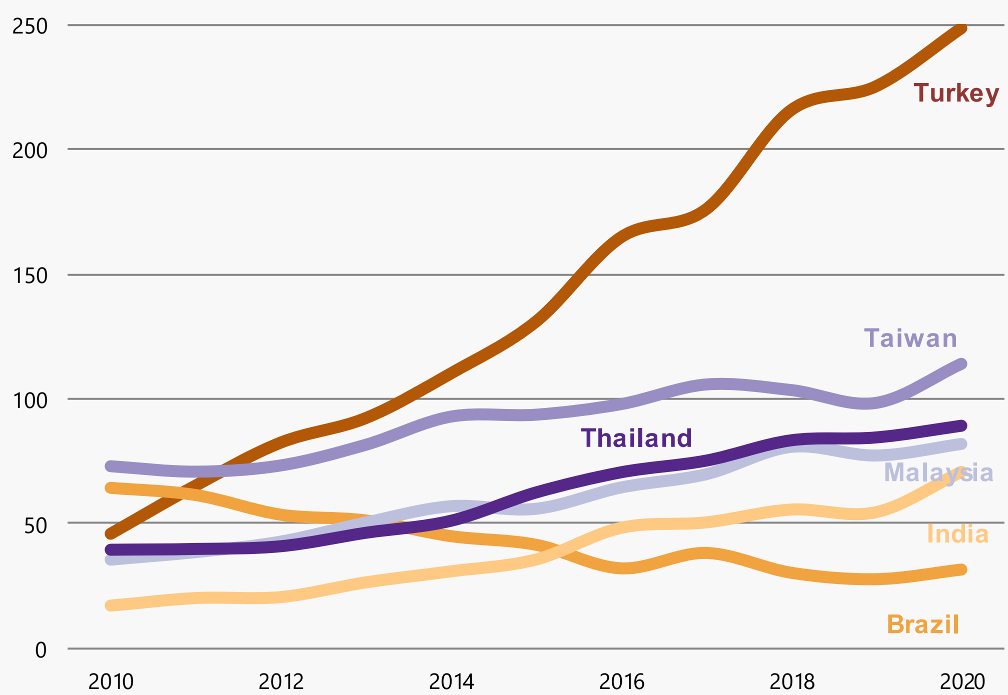
Other Major Exporting Countries

As described in chapter II "Nonwoven Supply," besides the three main producing regions (the European Union, United States and China), many other countries have recorded an important development of their local production over the last decade, giving them also the opportunity to increase their exports to the rest of the world (Table IV-2). This is provided in Figure IV-22 and Figure IV-23. The level of exports of these countries has—sometimes dramatically—changed in only 10 years.

Figure IV-22

Other countries: Yearly Export of Nonwovens (part 1)

2010-2020 (in 1,000 Tonnes)



Sources: National Statistical Institutes, 2021

While the exports of Brazil had been decreasing until 2019, the flows of nonwovens coming from Turkey, Taiwan, Malaysia, Thailand, and even India have shown significant growth rates, and the development of Egypt (Figure IV-24), Russia (Figure IV-25) and Saudi Arabia (Figure IV-26) will be of interest to anyone watching the industry's development on a global basis.

Turkey

Turkish production, which is part of the overall Greater European output analyzed in chapter II, recorded a continuous and impressive development. Turkey has been a net exporter of roll goods since 2012, and its development should be highlighted (Figure IV-22). From not more than 3,500 tonnes in 2000, Turkish exports showed tremendous growth rates since 2008. They reached 45,700 tonnes in 2010 and 248,100 tonnes in 2020. Turkey is now the first exporter after the three main suppliers (Table IV-2).

In 2020, a majority (53.4%) of these exports of nonwovens stayed in Europe; in particular, the European Union -- with now 27 member states -- was still the main destination (nearly 34.8% of the total exports). The United Kingdom accounted for 10.5%. North Africa, the U.S. and Middle East also became important markets, with respectively 14.2%, 12.4% and 9.9% of the Turkish exports.

Turkish imports from the rest of world peaked in 2010, with 80,500 tonnes. Since then, the volume of roll goods entering the country has been decreasing and was only 44,950 tonnes in 2019. Nevertheless, imports reached nearly 70,000 tonnes one year later. Most of these nonwovens (37,474 tonnes) came from the other European countries, but this 2020 imports increase came from the roll goods coming from China (+ 15,300 tonnes compared to 2019).

In terms of weight, 2020 trade flows of nonwovens were mainly in low grammage materials, in both exports and imports. Products weighing less than 70 gsm represented 80.8% of Turkish exports and 73.3% of Turkish imports.

Taiwan

Over the period 2012-2019 , Taiwanese imports have been stable around 25,000–27,000 tonnes, fairly split between spunlaid and fiber-based materials. However, imports increased by 63.5% in 2020 to reach 40.300 tonnes (an increase coming from low-weight spunmelt Chinese nonwovens). Considering all types of roll goods entering into Taiwan, 83.4% were Chinese products.

On the other hand, exports from Taiwan to the rest of the world increased by 41,000 tonnes in ten years, from 73,300 tonnes in 2010 to 114,300 tonnes in 2020 (Figure IV-22). Fiber-based products between 25 gsm and 70 gsm accounted for 44.4% of these exports. Nearly 80% of Taiwanese exports were delivered to other Asian countries; mainly to

China (25,900 tonnes), Japan (27,600 tonnes) and Vietnam (12,400 tonnes). Taiwan has exported around 10,000 tonnes to the United States since 2015.

Thailand

Over the period 2010–2019, as far as nonwovens are concerned, exports average growth rate was 8.9% (Figure IV-22) while imports grew annually at a lower speed (+4.5% in average). In 2020, Thailand exported 89,500 tonnes (+ 5.6% compared to 2019) and imported 42,300 tonnes of roll goods (+11.4% compared to 2019).

Most of these trade flows were spunmelt nonwovens. Nearly three-quarters (73.7%) of their exports ended in Japan, Indonesia or Vietnam, and 62% of Thai imports were supplied from China or Malaysia. In 2020, we also noticed an increase of spunmelt materials coming from Saudi Arabia (5,200 tonnes).

Malaysia

Over the period covered by this report, both Malaysian exports and imports grew at a similar speed (Figure IV-22). Malaysia is a net exporter of nonwoven roll goods. While the Malaysian trade balance was less than 21,000 tonnes in 2010, it reached 48,500 tonnes in ten years. The main reason was the growth of exports of low-weight spunlaid materials, which represented 72,200 tonnes of the 82,000 tonnes sold outside the country in 2020. The main destinations for Malaysian exports were Japan (30,000 tonnes), Indonesia (7,000 tonnes), Vietnam (6,800 tonnes) and China (6,700 tonnes).

India

Before 2008, India was nearly exclusively an importer of nonwovens. Since 2008, flows of roll goods coming in and going out of India have been tremendously increasing. Indian trade balance which was negative until 2019 turned to positive in 2020 as India imported less than exported for the first time ever.

India exported only 6,000 tonnes in 2008, 17,000 tonnes in 2010, and reached 71,100 tonnes in 2020 (Table IV-2 and Figure IV-22), of which 37,700 tonnes went to the United States, mostly spunlaid between 25 to 150 gsm.

In 2020, India imported 50,000 tonnes of nonwovens (-16.4% compared to 2019), of which 23,500 tonnes came from China, 5,650 tonnes from Malaysia, and 5,300 from the European Union countries. Indian imports are mainly spunlaid below 25 gsm (16,700 tonnes) and fiber-based materials between 25 gsm and 70 gsm (9,000 tonnes).

Brazil

In 2016, Brazil became a net importer country. In one decade, Brazilian trade balance in nonwovens roll goods has completely reversed; from over 36,700 tonnes in 2010 to -24,100 tonnes in 2020.

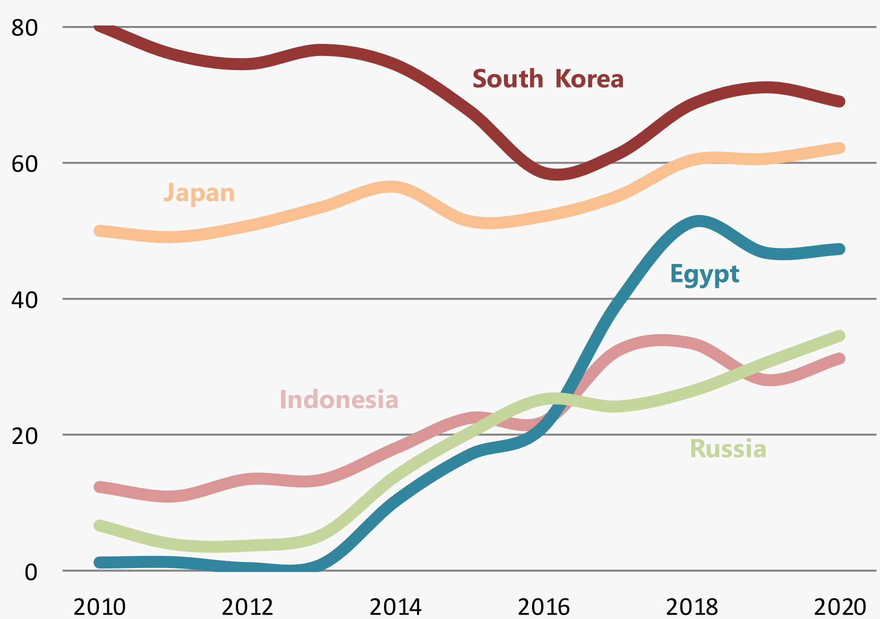
Brazil exports were continuously growing to a peak at nearly 65,000 tonnes in 2010 (Figure IV-22). Since 2011, though, exports have been decreasing with a slight rebound in 2020 when Brazil exported only 31,500 tonnes, of which 26,500 tonnes were of lightweight spunmelt products below 70 gsm. Nevertheless, 91.3% of the overall exports were sent to North, Central or South American countries. The decline of Brazilian exports observed since 2011 is mainly due to the decreasing sales to the other South American countries and the U.S., respectively -15,100 tonnes and -13,100 tonnes in 2020 compared to the levels reached ten years before.

Brazilian imports reached 55,500 tonnes in 2020, mainly from China (14,400 tonnes), Israel (11,000 tonnes), Argentina (9,300 tonnes) and Paraguay (8,700 tonnes). Only 34.2% of Brazilian imports were fiber-based materials.

Figure IV-23

Other countries: Yearly Export of Nonwovens (part 2)

2010-2020 (in 1,000 Tonnes)



Sources: National Statistical Institutes, 2021

South Korea

Although it was still in the top 10 exporters worldwide in 2020 (Table IV-2), South Korea recorded the worst nonwovens trade deficit in history (-135,000 tonnes). Since 2014, the South Korean trade balance in nonwovens roll goods has been negative.

In the long term, South Korean exports have been quite stable (Figure IV-23). In 2020, they reached the level of 69,000 tonnes, mostly spunmelt products (74%). South Korea exported mainly to other Asian countries -- Japan (22,200 tonnes), China (9,500 tonnes), and Vietnam (7,300 tonnes) -- but also to the United States (15,500 tonnes).

In terms of imports, accounting for 204,200 tonnes in 2020 (more than four times the level recorded in 2010), most of the nonwovens entering South Korea came from China (178,300 tonnes). The second supplier, in tonnage, was Japan, but with only 7,500 tonnes.

The free trade agreement between South Korea and the European Union, applied since July 2011, has had a limited impact so far on the flows of roll goods between the two regions, in both import and export.

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Japan

In 2010, Japan exported 49,800 tonnes of roll goods and imported 108,300 tonnes. Over the last decade, Japanese imports of nonwovens have increased by 149%, while exports increased only by 24.7% (Figure IV-23). In 2020, imports reached 269,000 tonnes (of which

146,000 tonnes were of spunmelt below 70 gsm) and exports only 62,100 tonnes (of which 35,400 tonnes were of fiber-based materials heavier than 70gsm). Most of the Japanese trade of nonwovens is done with the rest of Asia, in both exports (45,000 tonnes) and imports (253,600 tonnes).

Nonetheless, despite this very negative trade balance in weight, the gap in value is relatively less important. In 2020, the average price of exports was around 10.9/kg, but the average price of imports was 2.9€/kg. Both volumes and value of Japanese imports are probably impacted by intra-sales of Japanese companies having production facilities in other Asian countries.

Indonesia

Both Indonesian exports and imports increased over the period 2010–2020, and this country is still a net importer. In 2020, Indonesia imported 91,000 tonnes of nonwovens materials, mainly spunlaid from China (49,900 tonnes), Thailand (18,000 tonnes) and Malaysia (6,600 tonnes). Indonesian exports peaked in 2018 (Figure IV-23) and were still at a high level in 2020 (31,300 tonnes), mostly sent to Japan, China and Vietnam.

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Egypt

Egypt was a net importer in 2018, when its nonwovens trade balance became positive (Figure IV-24).

Egypt started to export higher volumes in 2014 to reach 47,200 tonnes in 2020. A large majority (66%) of the nonwovens sold outside the country were spunmelt materials below 25 gsm and sent mainly to the European Union (8,600 tonnes), Turkey (6,800 tonnes), Algeria (3,700 tonnes) and United States (3,700 tonnes).

In order to meet the development of its local demand over the period 2010-2019 (apart from 2018), Egypt needed to source roll goods (mostly spunlaid) from outside, mainly from Middle East and European countries. In 2020, imports decreased to 63,400 tonnes (it peaked at 70,100 tonnes in 2019), mostly spunmelt from the European Union countries, Turkey and Saudi Arabia.

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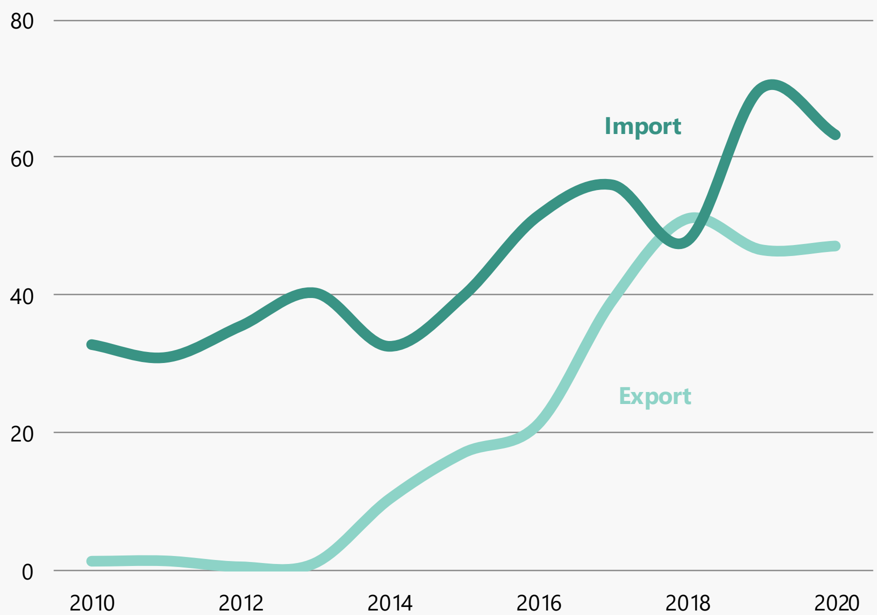
Figure IV-24

Egyptian Nonwovens Trade

Egypt, Yearly import & export of nonwovens
2010-2020 (in 1,000 Tonnes)



Sources: National Statistical Institute, 2021

Russia

Despite its continuous development, Russian production did not fulfill the local demand and, during the last decade, the Russian trade balance in nonwovens continues to show negative figures (Figure IV-25).

Russian imports significantly increased: from 41,000 tonnes in 2010 to 2014 when they reached 88,500 tonnes. After a decline of 25,000 tonnes in 2015, they increased again to reach 103,300 tonnes in 2020. According to the official statistics, 64.3% of these imports were spunmelt material.

Although exports were multiplied by five over the last ten years, the level of Russian nonwoven exports stayed at a relatively low level compared to imports (Figure IV-25). In 2020, 34,600 tonnes were exported by Russia, of which 7,600 tonnes went to Kazakhstan, 7,000 tonnes to Belarus, 5,800 tonnes to the European Union and 5,300 tonnes to Ukraine.

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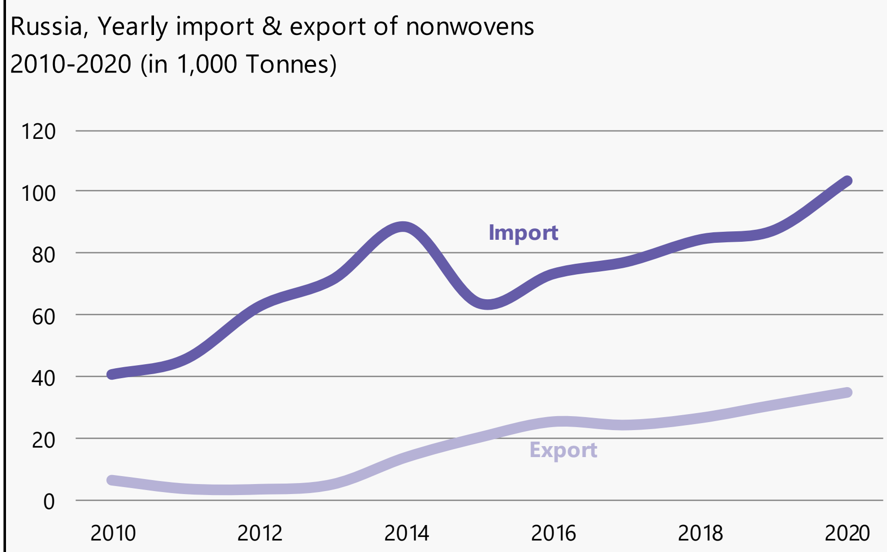
Figure IV-25

Russian Nonwovens Trade



Sources: National Statistical Institute, 2021

Saudi Arabia

Development in the flows of roll goods going out of Saudi Arabia, in particular since 2014, must be noted (Figure IV-26). In 2020, Saudi total exports of roll goods reached 63,400 tonnes. The most important volumes were delivered to EU27 countries (13,600 tonnes), other Middle-East countries (12,100 tonnes), the United States (10,700 tonnes) and China (10,000 tonnes). Nearly 83% of Saudi total exports were spunmelt materials below 70 gsm.

In 2020, Saudi Arabia imported 31,600 tonnes of roll good, of which 19,700 tonnes were from China. Of the total imports, 77% were spunmelt nonwovens.

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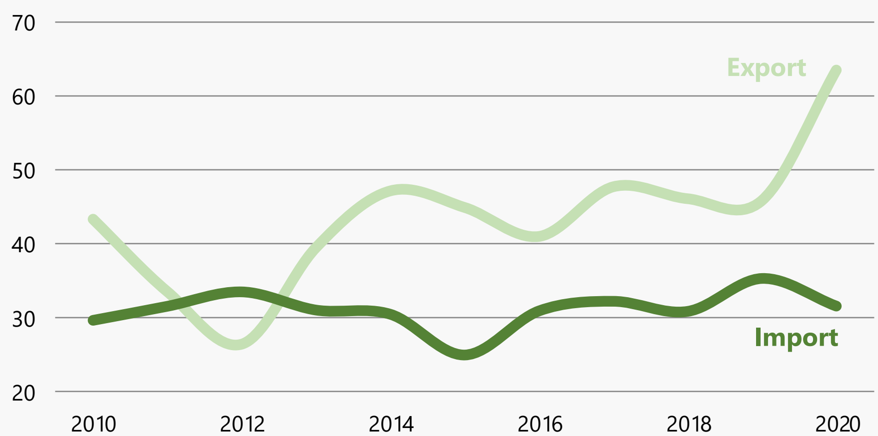
In 2020, Saudi Arabia imported 31,600 tonnes of roll good, of which 19,700 tonnes were from China. Of the total imports, 77% were spunmelt nonwovens.

Figure IV-26

Saudi Arabian Nonwovens Trade

Saudi Arabia, Yearly import & export of nonwovens
2010-2020 (in 1,000 Tonnes)



Sources: National Statistical Institute, 2021

V. APPENDIX

EDANA and INDA have undertaken this study to fulfill the element of their missions to provide credible statistics to their members and the overall industry. While no study is perfect, INDA and EDANA have taken the time and applied their knowledge to make this the most accurate and most comprehensive analysis of the worldwide nonwovens industry. This report presents the detailed production data for the worldwide nonwovens industry for 2010, 2015 and 2020, and a forecast for 2025. This information is intended to assist those in the nonwoven industry in making better business decisions.

METHODOLOGY

This information is provided in good faith by EDANA and INDA, and while we endeavor to keep the information up to date and correct, we make no representation or warranties of any kind, expressed or implied, about the completeness, accuracy, reliability, suitability, or availability with respect to the information, figures, or related graphics contained within this document.

Any reliance the user places on such information is therefore strictly at the user’s own risk. In no event will INDA and EDANA be liable for any loss or damage whatsoever, including indirect or consequential, arising from the loss of data or profits arising out of or in connection with the use of this information.

The time periods in the report refer to the final day of each of the years stated. For example, 2020–2025 is five years of data, as it refers to December 31, 2020, to December 31, 2025.

ACKNOWLEDGMENTS

EDANA and INDA want to give thanks to the industry-related organizations, companies and individuals for their assistance in preparing this seventh Global Nonwoven Markets Report. While INDA and EDANA prepared much of the statistics and figures, the task would have been much more difficult without their help.

Definitions

Following are definitions of terms used throughout the report. The nonwoven definition is now based upon the new International Organization for Standardization (ISO) definition, ISO 9092:2019 (E) adopted by the ISO in March of 2019.

Nonwoven

An engineered fibrous assembly, primarily planar, which has been given a designed level of structural integrity by physical and/or chemical means, excluding weaving, knitting or papermaking.

Fibrous Assembly: A predetermined amount and arrangement of natural or manufactured fibrous material such as, but not limited to fibers, continuous filaments, or chopped yarns of any length or cross-section. It can be a two- or three-dimensional alignment of fibrous materials made by a web-forming process.

Engineered: An application of science to design, plan, and manufacture products to utility specifications.

Structural Integrity: A measurable level of added tensile strength.

Physical and/or Chemical Means: A specific bonding technology that results in frictional forces between fibers (through entanglement) or adhesive forces between fibers (with or without the use of binders).

Web Formation Processes

The primary criterion used for categorizing nonwoven capacity and production is by its forming process. The nonwoven material forming process can be categorized into four distinct groups:

- Drylaid
- Spunlaid
- Airlaid Short Fiber
- Wetlaid

Drylaid

The drylaid web-forming process refers to dry staple fiber-based nonwoven webs, produced using either a mechanical web formation of carding/garneting or the aerodynamic web formation of airforming equipment, such as the Rando Webber machine. Carding equipment separates the fibers from each other impurities, aligns and delivers the fibers to the lay-down device where they are laid down as a web. The drylaid web is then thermally, chemically, or mechanically (needlepunch, hydroentanglement, or stitch-bond) bonded.

The drylaid processes are further defined in the report by the bonding processes below:

Needlepunch/Stitchbond: Needlepunch and stitchbond are separate bonding processes, but are combined into one category for reporting, due to the smaller size of the stitchbond category.

Needlepunch: Needlepunch mechanically binds a web to form a material by penetrating the web with an array of barbed needles that carry tufts of the web's own fibers in a vertical direction through the web.

Stitchbond: A bonding technique in which fibers in a web are bonded together by stitches sewn or knitted through the web to form a material. The stitching either strengthens or reinforces substrates, or brings an extensive number of alternative properties to the resulting composites. The finished material sometimes resembles corduroy, but can exhibit other designs.

Thermal/Chemical: Thermal and chemical are separate bonding processes but are combined into one category for reporting, due to the smaller size of the chemical category.

Thermal: Thermal bonding is a technique for bonding a web of fibers in which a heat, with or without pressure, is used to activate a heat-sensitive material. The material may be in the form of homofil fibers, bicomponent fibers, or fusable powders, as part of the web. The bonding may be applied all over (e.g., through or area bonding) or restricted to predetermined, discrete sites (e.g., point bonding). In ultrasonic bonding, heat is generated only at the bond site as the oscillating horn strikes the web on the anvil roll

Chemical: Chemical bonding, also known as resin bonding, is a method of bonding fibers by using chemical agents, which may include adhesive resins and solvents. Most common is adhesive bonding. Latex resins (adhesive) are applied to the web by a variety of methods: dipping the web into the latex and removing the excess, spraying, foaming, or printing. The resin is usually in a water-based solution, so this bonding process requires heat to remove the water to dry and set the binder into the material. This is sometimes referred to as latex bonding.

Hydroentanglement: Hydroentanglement is a method of bonding fibers, not a web forming process. The hydroentanglement technology is a system in which water is emitted under high pressures and velocity from closely positioned nozzles onto a web of loose fibers. The intensity of the water stream and the pattern of the supporting drum or belt entangle the fibers about one another. The entangling of the fibers and friction between the fibers yields a cohesive web.

Hydroentanglement is also known by several other names, including spunlace and spunlacing. INDA prefers to use the term hydroentanglement rather than spunlacing as there is potential for people unfamiliar with the industry to confuse spunlacing with spunlaid, spunmelt, and spunbond.

Spunlaid

The spunlaid process, often referred to as meltspinning, refers to spunlaid polymer-based nonwoven webs: spunbond, meltblown, spunbond and meltblown (spunmelt) composites (e.g., SM, SMS, SMMS, etc.), flashspun, and other types of nonwovens originating from polymers. Spunlaid is a web forming process in which the production line extrudes and supplies its own fibers from a molten polymer or polymer solution in one continuous process.

Spunlaid or meltspinning is composed of two main, and very different, processes; **spunbond** and **meltblown**. There is a clear distinction between the two technologies, with respect to the way in which filament spinning and web forming are performed in each process; this yields significant differences in both the physical web characteristics and productions rates.

Within the report the spunlaid processes are further defined by the web-forming processes below:

Spunbond/Spunmelt: Included within this category for reporting purposes are both spunbond and spunbond/meltblown composites.

Spunbond: Spunbond is a spunlaid technology in which the filaments have been extruded, drawn and laid on a moving screen to form a web. The term is often interchanged with spunlaid, but the industry has conventionally adopted the spunbond or spunbonded term to denote a specific web forming process.

Spunbond/Meltblown Composites: Spunmelt is a multiple layer material that is generally made of various alternating layers of spunbond and meltblown webs. Spunmelt is often referred to as SMS. SMS is also an acronym for the sequencing of processes within the spunmelt line; other examples are SM, SSMS, and SSMMMMS.

Meltblown: Meltblown is a nonwoven web forming process that extrudes and draws molten polymer resins with heated, high velocity air to form fine filaments that are deposited onto a moving screen or drum. In some ways the process is similar to the spunbond process, but meltblown fibers are much finer and generally measured in microns.

Other Spunlaid Processes: The other spunlaid processes use resins but are not spunbond or typical meltblown processes.

Flashspun: Flashspun is a modified spunlaid technology in which a polymer/solvent solution is extruded under conditions in which rapid solvent evaporation at the spinneret occurs so that the individual filaments are disrupted into a highly fibrillar form and are collected on a moving screen to form a web. When the solution is allowed to expand rapidly through the capillary, the solvent evaporates to leave a highly oriented nonwoven network of filaments.

DuPont developed the flashspun process in the 1950s. The flashspun product Tyvek® has been in use since 1959, but DuPont did not trademark the actual brand until 1965, making it available for commercial purposes in April 1967.

Coform: Coform is a nonwoven spunlaid process comprising a matrix of meltblown fibers and at least one additional material, often called the secondary material, which produces a particle-laden meltblown material. Coform is a technology where the web is formed through the turbulent mixing of air containing the component fibers and/or particulate particles into a meltblown web.

Examples of the secondary material include absorbent fibrous organic materials such as wood and non-wood pulp from, for example, cotton, rayon, recycled paper, fluff pulp; superabsorbent materials such as superabsorbent particles and fibers; inorganic absorbent materials and treated polymeric staple fibers; and other materials such as non-absorbent staple fibers and non-absorbent particles and the like.

The most notable of the coform structures were developed by Kimberly-Clark involving wood pulp fibers and 3M's Thinsulate™ with polypropylene or polyester staple fiber.

Cross Laminated: The cross laminated process involves coextruded filaments, typically using high-density polyethylene (HDPE), low-density polyethylene (LDPE), polypropylene or polyester. It is a highly sophisticated process that starts with a co-extrusion and ends with an extremely accurate scrim of cross laminated strands.

Wetlaid

Wetlaid is a web forming process in which fibers are suspended in water. The suspension is distributed homogeneously over a forming wire or screen conveyor belt or perforated drum to create a web. Wetlaid nonwovens are produced through a process similar to papermaking. Many wetlaid nonwovens are made with wood pulp or other natural fibers blended with synthetic fibers or glass.

In a wetlaid process in which cellulose or other fibers are engineered to a level of structural integrity by physical and/or chemical means other than hydrogen bonding, the assembly can be considered to be a nonwoven.

Paper is traditionally regarded as a thin material produced by pressing moist, refined cellulose fibers together and drying them to create a hydrogen-bonded sheet. The fibers in paper are typically short and extracted from a water suspension. When rewet, the hydrogen bonds between fibers are broken, and paper typically loses almost all of its strength. In some papers, to achieve wet strength, a polymeric binder (referred to as wet strength resin) is added to the structure. The refined fibers, plus the self-bonding that occurs between cellulose fibers during drying, distinguish paper from nonwovens.

Airlaid Short-Fiber

The airlaid short-fiber process, originally conceived as a way to make paper without water, refers to a way of laying shortcut staple fibers, typical of a Kroyer/M&J or Dan-Web line, dispersed by air through a forming head to form a continuous web.

Similar to the wetlaid process, the airlaid short-fiber process also allows the ability to lay down short fibers. Short-fiber airlaid typically uses cellulose from wood pulp but can use cotton linters and other natural fibers. Other fibers used included synthetic polymers like polyester and nylons; inorganics like glass silica and metal; and reclaimed fibers such as leather and other textile waste. These fibers can be 100% homogeneous fibers or a blend. Other material can also be added, such as superabsorbent polymer, in the air transportation process or between the fiber forming heads

The web requires a bonding step to stabilize the structure prior to being rolled up. There are many bonding technologies that can be utilized, typically involving a chemical, thermal, or mechanical process.