

Environmental Key Performance Indicators for Tire Manufacturing 2009-2021

Tire Industry Project
2022



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① Introduction



1 Introduction

Operating under the umbrella of the World Business Council for Sustainable Development (WBCSD), the Tire Industry Project (TIP) is the primary global forum on sustainability topics for the tire industry. Founded in 2005, TIP is a voluntary CEO-led initiative that brings together ten leading companies in the sector, representing more than 60% of global tire manufacturing capacity.

TIP's aim is to proactively identify, understand and address the social and environmental impacts associated with the life cycle of tires to contribute to a sustainable future.

The evolution of mobility is central to a more sustainable world and TIP members recognize that there are both challenges and opportunities associated with tire manufacturing. We are working to maximize the latter and address the former to keep the sector continuing on the sustainability path.

To monitor and disclose the sustainability journey, in 2017 we published our first annual report on members' performance against a series of environmental indicators. Now in its fifth edition, the report provides an overview of how TIP members performed between 2009 and 2021 on energy consumption, CO₂ emissions, water withdrawals, environmental management and waste generation. This report discloses the performance of our members in these areas both in absolute and in intensity-based terms, relative to total production output.

WBCSD's vision is that by 2050, humanity has optimized resource use to meet society's needs while allowing the regeneration of the systems that provide resources. To achieve this vision, in 2021, TIP launched [Sustainability Driven: Accelerating Impact with the Tire Sector SDG Roadmap](#). The roadmap offers a framework for action that outlines impactful

pathways for the tire sector to contribute to the ambitions of the United Nations Sustainable Development Goals (SDGs), which themselves lay out a global agenda to tackle the world's most pressing social, environmental and economic challenges by 2030. Our key performance indicator (KPI) reporting is central to the roadmap, which aims to guide, inform and support decision-making along the value chain, encourage stakeholder dialogue and inspire action-oriented initiatives among industry peers and beyond.

The tire sector interacts with all 17 SDGs; however, the SDG Roadmap for the tire sector focuses on areas where the sector has the greatest potential to lead, influence and accelerate action to make progress on the 2030 Agenda. The roadmap identifies eight SDGs (Figure 1) as priorities and where the tire sector can have the highest impact through multistakeholder action.

Figure 1: SDGs targeted by the tire sector roadmap



We understand that monitoring the progress of individual TIP companies and the tire sector in their implementation of the roadmap will be important to ensuring that the sector remains focused on optimizing its contributions to the SDGs. TIP's ongoing work to track and report sector environmental KPIs will play a central role in that monitoring.

We have expanded our reporting over the years, introducing more qualitative information and examples of projects that help to contextualize the quantitative data. Starting this year, the report introduces a new KPI for

total waste generation. While the current report focuses on KPIs for members' operations, we expect that future editions will see the addition of new KPIs from across the tire life cycle as we continue to enhance transparency and disclosure in the tire sector.

In June 2021, our member Goodyear acquired another of our members, Cooper Tire. The integration reduced the total number of members from 11 to 10. The acquisition and consolidation of the two companies continued through the remainder of 2021; accordingly, this report provides

separate data sets for Goodyear and Cooper Tire, with the intent to report consolidated results in the next edition.

dss+, a leading provider of operations management consulting services in sustainability, health and safety, prepared this report. dss+ acted as an independent third party, collecting, collating and analyzing the data supplied by TIP members and drafting this report. The Methodological note on page 32 contains more details about the collection methods and definition of indicators used in the report.

MEMBERS OF THE WBCSD TIRE INDUSTRY PROJECT



② State of play: Policies, strategies and trends



② State of play: Policies, strategies and trends

The development and 2021 deployment of COVID-19 vaccines allowed many sectors of the economy to resume activity.

After a steep decline in production in 2020, the tire industry rebounded strongly when the recovery from the COVID-19 pandemic began in 2021, with TIP members posting a 17% year-on-year rise in output. This had repercussions on virtually all the environmental indicators disclosed in this report, because increases in production may involve greater resource consumption and potential environmental impacts. Over the years, TIP members have reduced their environmental impacts, so those impacts associated with increases in production have gradually decreased on a marginal basis.

Sustainability has been one of the driving forces behind the reduction in environmental impacts thanks to TIP members

embedding environmental, social and governance (ESG) considerations into their operations and business strategies. The other driving force has been the volatility in commodity prices, a common concern for industries. Energy prices jumped significantly throughout 2021 even before the geopolitical situation in Eastern Europe began to deteriorate towards the end of the year. For instance, gas prices in the United States rose by 40% between January and December 2021,¹ with many other large markets subsequently experiencing similar shifts. Another example is the price fluctuation of natural rubber after dramatically sinking in April 2020. The price of rubber almost doubled on several major stock exchanges by the end of 2020 and remained high throughout the first half of 2021.

The conflict in Ukraine, which was looming towards the end of 2021, will likely have an impact on the tire sector and the automotive industry more

broadly in 2022. We will highlight those impacts in the next edition of this report. While the full spectrum of consequences of the conflict is still being understood, expectations in the automotive industry are for it to impact the production of vehicles and parts in Europe and the trade in automotive parts between Europe and Asia. The most significant impacts of the conflict on the tire industry are expected to be indirect and to include the rise in energy prices, monetary instability, demand volatility, and the disruption of regional and global supply chains for basic commodities.

Overall, the other main trends that impacted the environmental performance of TIP members in 2021 were:

- The drive to expand corporate sustainability strategies beyond climate change
- Significant growth in responsible sourcing
- Advances in technology.



2.1 A DRIVE TO EXPAND ESG STRATEGIES BEYOND CLIMATE CHANGE

Momentum behind climate action was significant in 2021. In November of that year, the United Nations Climate Change Conference (COP26) culminated in dozens of pledges from governments and more than one hundred trillion dollars in financing for climate action.² Additionally, thousands of companies, cities and other actors have joined global efforts to reduce emissions.

At the same time, stakeholders have increasingly urged businesses to advance their ESG strategies beyond their operations to reflect the interconnected nature of sustainability issues encountered throughout the value chain – impacting areas such as climate change, biodiversity and human rights. Issues like labor rights, biodiversity loss, health and safety, and waste and pollution are becoming prominent features of national policy and legislation and corporate sustainability strategy.

2.2 THE GROWTH OF RESPONSIBLE SOURCING

In the tire industry, the drive to address environmental and social impacts has led to increased focus on supply chains, particularly the natural rubber supply chain, which has

been linked to discussions about deforestation and land rights. The tire industry uses 70% of the natural rubber produced globally³ and TIP members are working, through the Global Platform for Sustainable Natural Rubber (GPSNR), to ensure that suppliers achieve human rights and environmental expectations. In alignment with GPSNR principles, TIP members have introduced responsible sourcing policies for natural rubber and are auditing their supply chains and working with their suppliers to address environmental and social issues when they arise.

Echoing the broader focus on responsible sourcing, GPSNR introduced an extensive and mandatory reporting requirement in 2021. The disclosure requires tire companies to detail their efforts to prevent deforestation, human rights violations and corruption in supply chains, among other topics.

2.3 TECHNOLOGY BRINGS BENEFITS ON MULTIPLE FRONTS

Reflecting the developments in the wider automotive industry, TIP members have increasingly leveraged research and development to improve the performance of the sector in areas such as traceability, creating new market opportunities, and generating operational efficiencies to cut costs and reduce environmental impacts.

For instance, the use of computer modelling and simulation has sped up the development of tires, shortened the go-to-market time, and reduced waste. Automating production and assembly using artificial intelligence has also increased efficiency and reduced resource use. Radio frequency identification (RFID) embedded in some tires has facilitated their traceability and the monitoring of supply chains, which has become an area of focus for the industry.

TIP members have also invested heavily in developing intelligent and connected tires that enable users to monitor tire health, inflation pressure and temperature, helping to prolong the life of the products and thus preventing waste. TIP members have been exploring airless tires, with early results showing that they may last longer and improve fuel efficiency compared to conventional tires. Additionally, TIP members have been developing new materials from bio-based or recycled sources that can partially displace both synthetic and natural rubber in tires.

③ Key performance indicators



3 Key performance indicators

3.1 SUMMARY OF KPIS

Since the start of reporting in 2009, TIP members have monitored the performance of their manufacturing sites using four KPIS: energy consumption, CO₂ emissions, water withdrawals, and the ISO 14001 certification status of their sites. This edition of the report introduces a new KPI: total waste generated. Figure 2 (below) shows the change over time for the five environmental KPIS, expressed in absolute terms, with 2009 being considered the base year for all KPIS except for total waste, which uses 2014 as the base year.

The scope of the data collection for the first four KPIS was TIP members' manufacturing sites, which totaled 241 sites in 2021. For the fifth KPI, total waste generated, the scope also includes offices and on-site catering facilities. Additional details on the scope of this KPI are reflected in section 3.11.

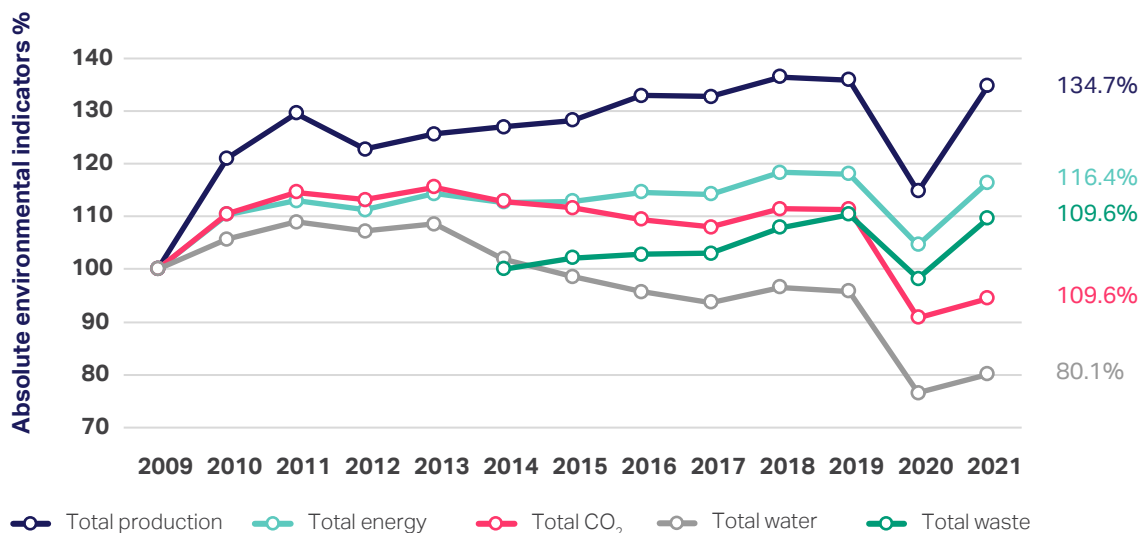
COVID-19 recovery in 2021 had a significant impact on the sector's KPI performance, particularly via rebounding **production** levels, which almost returned to pre-pandemic levels in 2021. The total **energy consumption** and **waste generated** in operations also returned to 2019 levels due to their strong correlation with production. For example, an 11.4% drop in absolute energy consumption in 2020 as production dropped steeply was followed by a strong rebound of 11.2% in energy consumption in 2021 as production demand rose.

CO₂ emissions correlated strongly with total energy consumption until 2015, when they started to decouple due to a ramping up of energy efficiency programs (and concurrent reduction in energy intensity), a gradual phasing out of fossil fuels in TIP members' energy mix, and an increased use of renewable energy.

Also, it is important to note that we used updated International Energy Agency (IEA) emissions factors for 2021 to calculate TIP member companies' CO₂ emissions for this reporting year, where previously we used 2014 factors. The increased proportion of renewables in many national grids during this time led to reductions in these factors, which in turn contributed to reductions in the reported CO₂ emissions from TIP member companies.

Total **water withdrawals** showed the largest decrease of all of the KPIS since 2013. While water withdrawals used in manufacturing typically correlates with production, and despite the return to 2019 production levels, total water withdrawals were still considerably lower in 2021 versus 2019. This can be explained by increased water efficiency, which led to a decrease in tire-production water intensity.

Figure 2: Absolute environmental indicators (production, energy, CO₂ and water, base year = 2009; waste base year = 2014)



For energy consumption, CO₂ emissions, water withdrawals and total waste generated, we have also calculated intensity-based KPIs (Figure 3). They represent the ratio between the absolute indicator and total production. Intensity KPIs are useful in measuring the resource use efficiency for resources like water and energy, and for production efficiency more broadly. Figure 3 illustrates the evolution over time of the intensity KPIs compared to total production.

Overall, energy, water and CO₂ emissions intensity have been on a downward trend since 2009. For energy intensity, the COVID-19 pandemic interrupted this trend in 2019 and 2020, which led to a 21% decrease in total production year-over-year. As a result, between 2019 and 2020, **energy** intensity increased 5.3% year-on-year as some

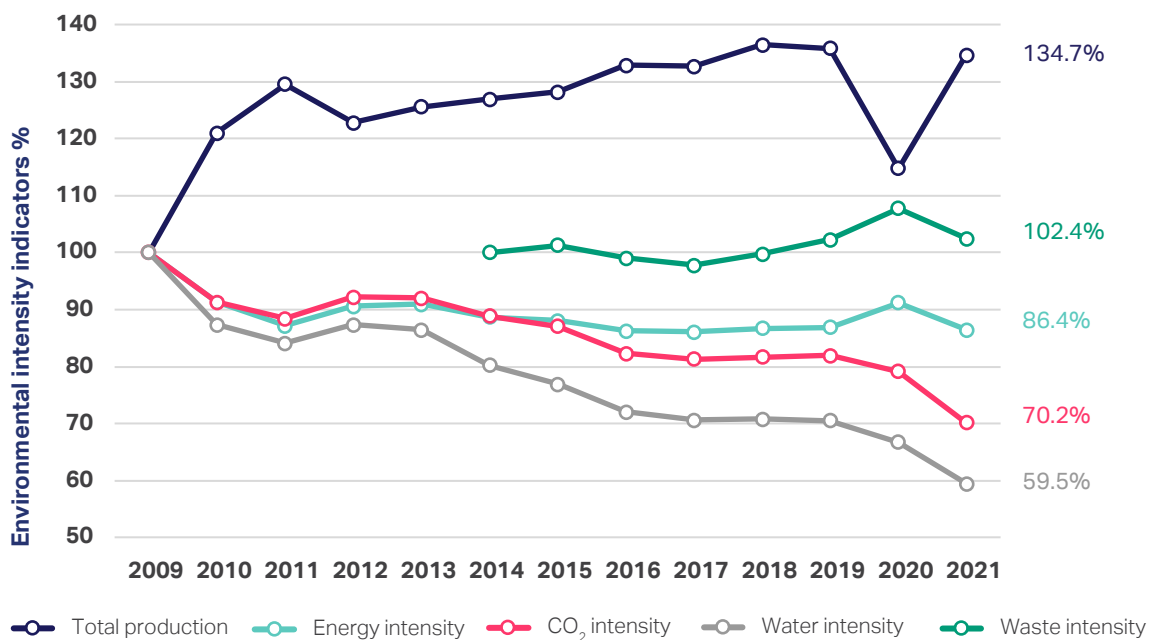
energy-intensive manufacturing sites continued to operate despite a slowdown in overall production.

Waste intensity remained stable from 2014 to 2021. The peak in waste intensity observed in 2020 was due to lower production values caused by the COVID-19 pandemic coupled with manufacturing facilities that remained open and continued to generate waste.

The biggest gain in efficiency can be observed for **water**. Water intensity decreased by 41% between 2009-2021, despite an increase in production and water withdrawals due to COVID-19 recovery. The implementation of water stewardship policies and water conservation actions have led to improvements in water efficiency.

It is important to note that there are differences between the historical data included in this report (the data up to 2020) and the data included in the previous edition of this report. The differences stem from the use of updated emissions factors for scope 2 emissions and the identification of minor inconsistencies upon the revision of historical data. These inconsistencies related to (1) two TIP members having used emissions factor databases that differed from those used by other members (this has been amended to allow homogenous analyses across the whole reporting period and across all companies); and (2) the now amended over-reporting (by a count of two sites) of the total number of manufacturing sites within the membership.

Figure 3: Intensity-based environmental indicators* (energy, CO₂ and water base year = 2009; waste base year = 2014)



*Unit of energy, water withdrawals of CO₂ emissions per unit of production.

3.2 ENERGY

Energy is a crucial input in tire manufacturing. The generation of steam and compressed air, cooling and powering industrial machinery are particularly energy-intensive.

Since the start of reporting in 2009, the absolute energy consumption of TIP members has largely reflected the overall production values, which in turn have followed the broader economic context. As production dipped in 2009 due to the financial crisis and again in 2020 due to the COVID-19 pandemic, absolute energy consumption followed the

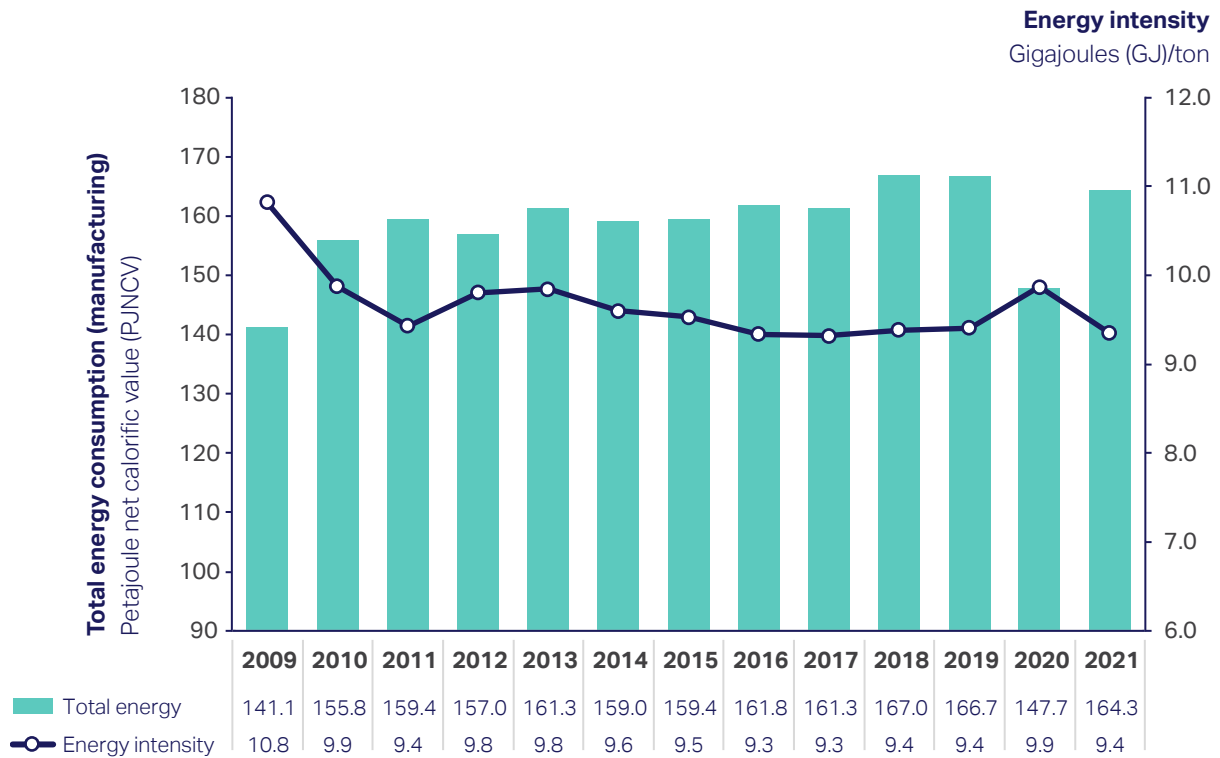
same trend. In 2020, absolute energy consumption decreased 11.4% as production stalled and a rebound of 11.2% in energy consumption followed in 2021.

As production increased in 2021, the energy intensity – measured in GJ per ton of product – returned to its pre-pandemic levels of 9.4, down from 9.9 the year before. The reason behind the increase in energy intensity in 2020 is that, when production dropped abruptly, many companies continued running energy-intensive equipment because turning it off required time and significant levels of energy. This affected

energy intensity, which increased by 5.3% year-on-year between 2019 and 2020.

Previously, between 2012 and 2019, both absolute energy consumption and energy intensity experienced a period of stability thanks to improvements in technology and TIP members' sizeable energy efficiency efforts. Energy intensity slightly decreased during this time, despite a small but sustained increase in absolute energy consumption that reflected the overall increase in production volumes.

Figure 4: TIP members' total energy consumption and energy intensity from 2009 to 2021



3.3 EXAMPLE OF ENERGY POLICIES AND GOVERNANCE

An important focus of TIP members' decarbonization efforts has been the transition to renewable energy, coupled with electrification and energy efficiency efforts. In 2021, TIP members made significant strides on all these fronts. The biggest change compared to 2020 was an increase of more than 50% in the sourcing of renewable electricity, both purchased and self-generated. Renewable electricity now accounts for 6.1% of the total energy mix of TIP member

companies and for 15.5% of the power mix. More details about the energy mix are available in section 3.4.

All members have been pursuing energy efficiency in operations and logistics for many years. In addition to quick wins like swapping incandescent lightbulbs with LEDs, many members are pursuing ambitious energy-efficiency projects with focused efforts on energy consumption hotspots.

To achieve decarbonization targets, TIP members also made changes to their governance

systems. Several companies have put in place cross-functional governance bodies, such as energy or climate committees, that often include senior leadership among their members or report directly to senior leadership. This creates clear accountability in achieving energy and climate targets. Likewise, TIP members are actively working to translate corporate decarbonization targets into plans and activities at the production site level, with these sites ultimately responsible for implementing operational changes to reduce energy consumption and greenhouse gas emissions.



Implementing energy-efficiency projects

Hankook has been working to optimize its compressed air systems because they account for up to a quarter of the company's total

electricity consumption. Efficiency improvements to this system would reduce the overall energy demand of production operations. Using air leak

scanners, Hankook is now able to estimate leak volumes and hole sizes and prioritizes leak remediation activities based on this data.

How TIP members are adjusting their governance structures to meet their climate and energy targets

Hankook set up its first ESG committees in 2010. Since then, some eight ESG steering committees have addressed issues that are material to the business and its strategy, such as safety, health and environment (SHE). An ESG Strategy Committee that responds to senior leadership ensures that ESG is woven into the company's growth strategy and its day-to-day activities.

Goodyear launched its corporate responsibility framework, Goodyear Better Future, in 2018 to enhance the existing governance of its high-priority topics. The framework helps ensure the integration of corporate responsibility into all levels of Goodyear's organization, promotes communication and awareness, and drives alignment with the company's corporate strategy and stakeholder priorities. In December 2021, Goodyear

announced its climate ambition, which includes the goal to reach net-zero Scope 1, 2 and certain direct Scope 3 greenhouse gas (GHG) emissions by 2050, aligned with the Science-Based Targets initiative (SBTi) and its new Net-Zero Standard. Goodyear also announced its commitment to achieve near-term science-based targets by 2030, including reducing Scope 1 and 2 emissions by 46% and certain direct Scope 3 emissions by 28%, as compared to 2019.

Toyo Tires established a Sustainability Committee, chaired by its president, in 2021. The company also set up a decarbonization task force that oversees its efforts to reach carbon neutrality by 2050 and reduce CO₂ emissions by 46% between 2019 and 2030.

Pirelli set up a Sustainability Strategic Committee in 2004. The CEO chairs it and it includes the company's top

management, representing all the organizational departments. The committee has strategic responsibility and holds ordinary meetings at least twice a year. In addition, in 2021, the company set up an Operational Sustainability Committee, chaired by its Deputy CEO, to oversee the strategic and operational management of its sustainability issues as they relate to climate change and diversity, equity and inclusion, among others.

Yokohama is working on establishing seven energy-saving subcommittees under its Carbon Neutral Committee to promote energy efficiency. The company is maximizing energy efficiency through system improvements, process improvements, and the introduction of new production systems, among others.

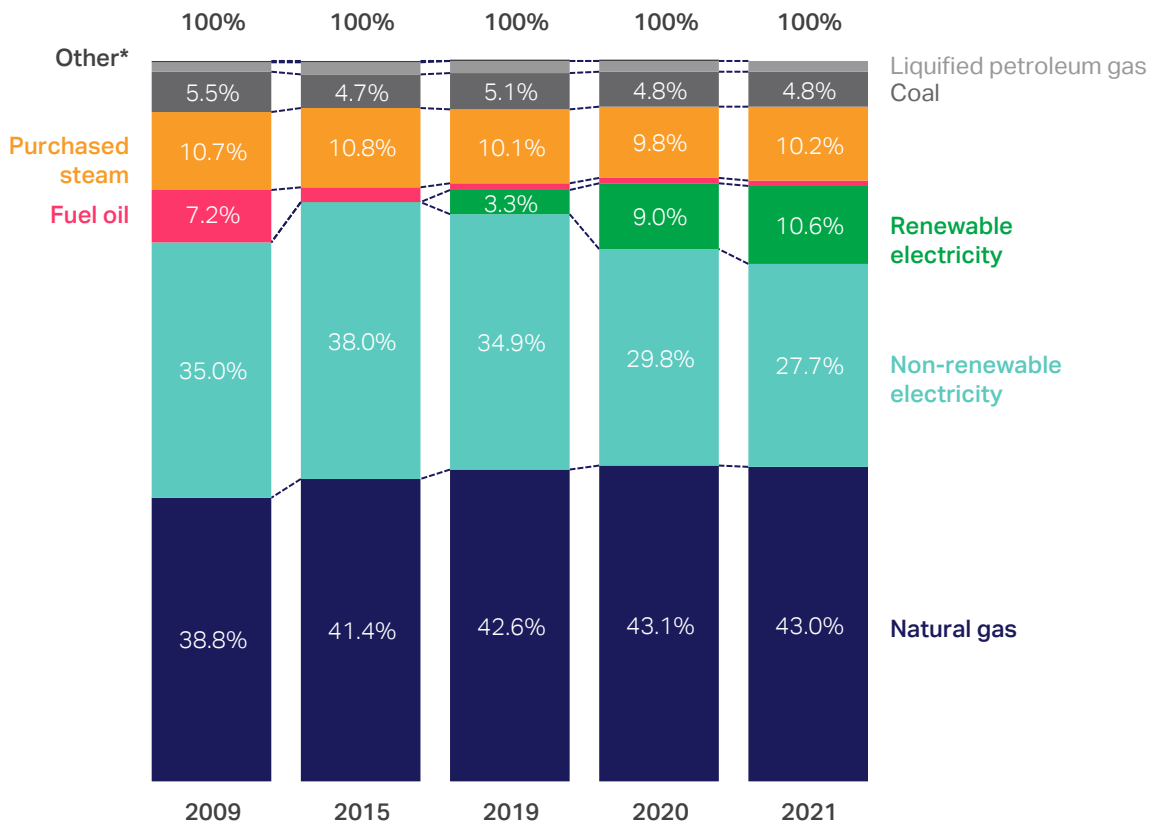
3.4 ENERGY – FOCUS ON THE ENERGY MIX

Since 2009, the energy mix of TIP member companies has evolved to phase out or reduce carbon-intensive energy sources like fuel oil and coal, in favor of fossil fuels with lower carbon footprints like natural gas and renewable energy.

The biggest change in the energy mix observed was due to an increase in renewable electricity from 9% of the total energy mix in 2020 to 10.6% in 2021 (Figure 5). (Renewable electricity figures reflect the renewable energy purchased by TIP members, which includes certificates and other means of purchasing.)

Some TIP members saw up to five-fold increases in the amount of renewable electricity purchased between 2020 and 2021. Opportunities for improvement remain as fossil fuels continue to account for the largest share of TIP members' energy mix, including natural gas (43% in 2021) and non-renewable electricity (27.7% in 2021).

Figure 5: The evolution of TIP members' energy mix between 2009 and 2021



*Petrol, propane, biomass

Diversifying the energy mix

In 2021, **Bridgestone** switched to 100% renewable energies for its purchased electricity at all Bridgestone EMIA (Europe, Middle East, India and Africa) plants in Europe, as well as at four plants in Japan and two plants in China. The Chonburi plant in Thailand also started producing 1 MW of solar power in 2021 thanks to the installation of photovoltaic panels.

Continental Tires began procuring 100% of its electricity from renewable sources for the first time in 2020. This resulted in a 70% reduction in its global CO₂

emissions in 2020 compared to 2019. Switching to renewable energy, particularly through special electricity-supply agreements and the purchase of energy-attribute certificates, is part of Continental's strategy to reach carbon neutrality by 2050 at the latest.

Yokohama aims to reduce its operational CO₂ emissions by 38% by 2030 compared to 2013 levels and to achieve net-zero CO₂ emissions by 2050. Its approach has involved working to develop a flagship carbon-neutral manufacturing facility at Shinshiro-minami by 2030 and adapting this model for other plants in Japan and globally.

In 2021, **Pirelli** used certified renewable sources for 100% of the electricity purchased from the grid at its sites in Europe and Turkey representing. The company aims to source 100% of its electricity from renewable sources by 2025 and to achieve carbon neutrality in its operations by 2030. To achieve these targets, Pirelli will follow its Carbon Action Plan, which encompasses initiatives like sourcing waste wood from local suppliers in Brazil to generate steam.



3.5 CO₂ EMISSIONS

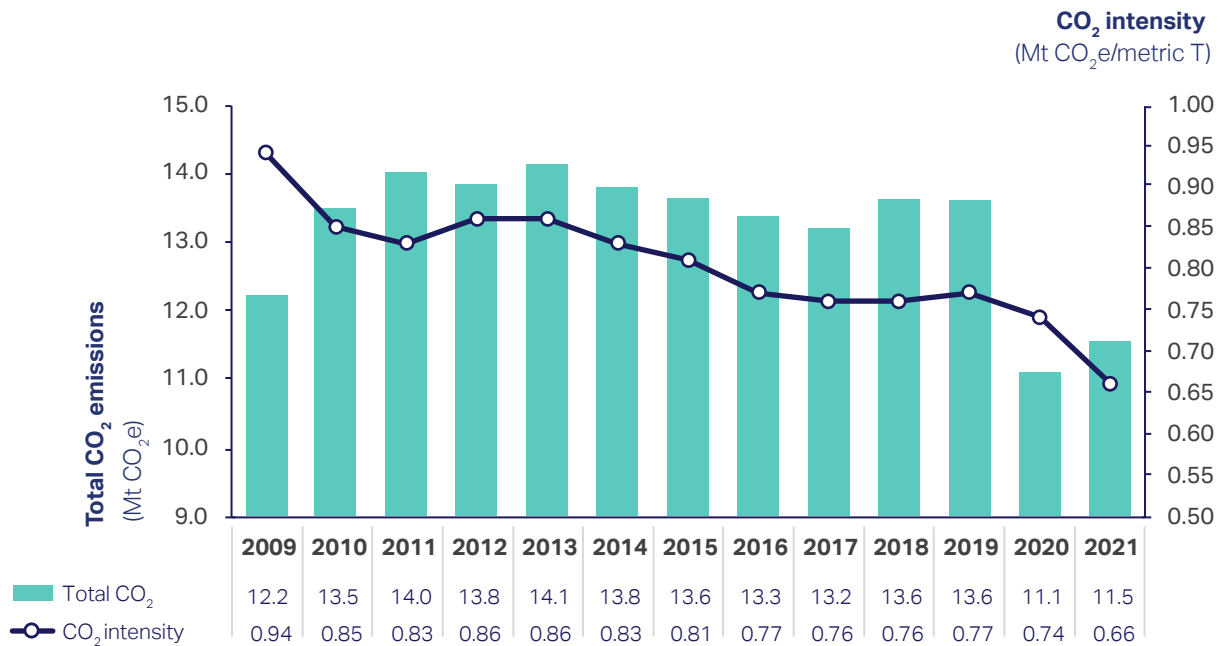
Up until 2020, the evolution of CO₂ emissions intensity (measured as the total amount of CO₂ emissions in a million tons of CO₂ equivalent divided by production in metric tons) associated with the operations of TIP members followed a similar trend to energy intensity: it decreased significantly as production levels resumed after the financial crisis, increased slightly between 2012-2013, and then followed an overall downward trend until 2016, when it plateaued.

The COVID-19 pandemic led to a decrease in CO₂ emissions intensity in 2020, following a decrease in overall production and an 11.4% decrease in energy consumption, as noted in section 3.2.

The most notable development related to CO₂ emissions is the marked decoupling of energy consumption and emissions that took place in 2021. Even as energy consumption rose by 11.2% year-over-year in 2021, CO₂ emissions only increased by 4% in absolute terms. Despite a 17.4% increase in production, CO₂ emissions intensity decreased by 11.3% in 2021. TIP members achieved this positive result by increasing the consumption of renewable electricity by 25% through the purchase of electricity with energy attribute certificates (EAC) and the self-generation of renewable electricity.

Note also that this reporting year saw updates to the International Energy Agency (IEA) emissions factors used in TIP CO₂ emissions reporting, replacing previously used 2014 factors with those for 2021. Reductions in the average emissions factors in this timeframe, as a result of the growing proportion of renewable energy used in national grids, contributed in part to the reductions observed in TIP members' CO₂ emissions herein. For identical sets of company data, the updated emissions factors alone brought about a 5% reduction in total CO₂ emissions and in turn contributed to the observed reduction in CO₂ intensity.

Figure 6: TIP members' total CO₂ emissions and CO₂ intensity from 2009 to 2021



3.6 EXAMPLES OF DECARBONIZATION PROJECTS AND PROGRAMS

Some of the projects that delivered a reduction in GHG

in 2021 included members switching to renewable energy, rethinking governance structures to roll out energy and climate change plans, and improving energy efficiency. We

list them in sections 3.2-3.4. In addition to these efforts, in 2021 TIP members carried out noteworthy decarbonization projects including those described below.

In 2020, **Michelin** identified the most impactful activities to decarbonize its operations and estimated the capital expenditure related to their implementation within the decade. The activities include (i) electrifying processes; (ii) improving the performance and control of tire curing equipment (insulating press open/close) and motor drives; (iii) increasing the efficiency of utilities (steam, compressed air and cooling production); and (iv) installing new heat pumps. Together, they are expected to improve energy efficiency by 37% by 2030 compared to 2010. Each manufacturing facility at Michelin is required to develop its own 2030 roadmap that reflects the corporate-level targets. In 2021, 15 of Michelin's 70 sites drew up their plans and a further 20 facilities were in the process of developing theirs.

In February 2021, **Sumitomo Rubber Group** committed to carbon neutrality by 2050. In August, the company unveiled its plan to reach the target, as well as detailing its intermediary targets – like reducing total CO₂ emissions from all its global manufacturing plants by

50% by 2030 compared to 2017 levels. To reach its targets, Sumitomo Rubber Group is working to reduce its energy consumption while expanding co-generation and the use of solar power. The company has also begun a proof of concept to evaluate the effectiveness of shifting to hydrogen-fired boilers in the manufacturing of tires. Decarbonizing the vulcanization of tires, which entails the use of steam boilers, is one of the important challenges to reducing operational emissions from tire manufacturing, therefore this initiative could make a significant contribution to Sumitomo's efforts to achieve carbon neutrality. In August 2021, the company launched verification testing of hydrogen-fired boilers at its Shirakawa manufacturing plant in Fukushima prefecture in Japan to identify and solve issues arising from the operation of such boilers, such as NOx emissions.

Goodyear has been using automation and other technologies to reduce its energy use at different production plants. For instance, automated oil temperature control in the mixing area at its Adapazari plant in Turkey improved pump motor efficiency by 68%, reduced machine down time and achieved

a quick investment payback of less than two months.

Toyo Tires is working to improve the efficiency of its compression systems and to prevent steam leaks and air leaks. Coupled with other energy efficiency measures and with a shift to renewable energy, this will help the company achieve its target of reducing CO₂ emissions by 46% by 2030 compared to 2019 and to become carbon neutral by 2050.

Pirelli continued to replace less-efficient conventional lighting with LED systems at its production sites last year, as well as to digitalize its energy management and expand its real-time energy carrier measurement network through its interconnection with building energy management systems (BEMS). The company also worked to improve the efficiency of its thermal conversion and recovered thermal waste to use it in the heating of its premises. Furthermore, it worked to improve the performance of its steam generation through flue gas recovery, of combustion air pre-heating systems, of compressed air generation, and of energy flows.

TIP members are also engaging with the Science Based Targets (SBTi)

TIP members are also engaging with the Science Based Targets initiative (SBTi) to provide a framework for their decarbonization strategies. At present, SBTi

has validated the science-based targets of 30% of TIP members, 40% have committed, and 30% have not yet committed. We will include the engagement of TIP members with the SBTi

as a formal indicator in next year's KPI report in order to measure members' progress on submitting their SBTs and ultimately having these targets validated.

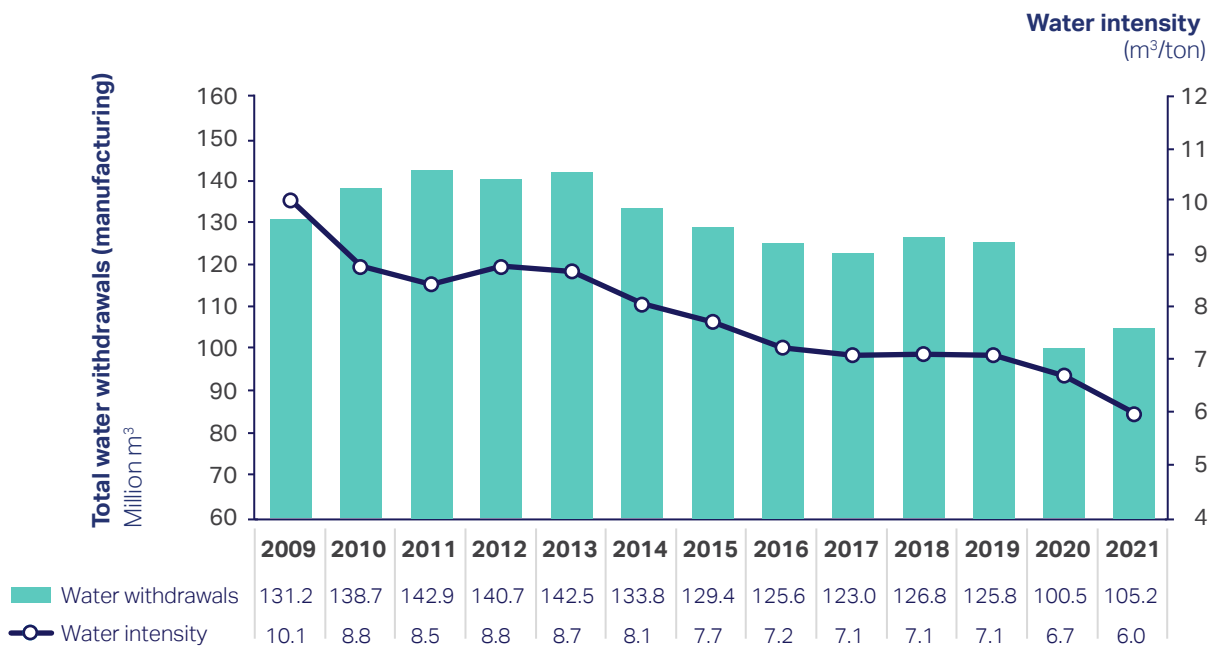
3.7 WATER WITHDRAWALS

Water is an essential resource for tire manufacturing at all stages of production, from cultivating natural rubber to curing the final product. As such, TIP members recognize the importance of reducing their water footprint, particularly in water-stressed areas. In this context, two TIP members use the Aqueduct Water Risk Atlas tool developed by the World Resource Institute (WRI) to assess water stress at the basin level and identify water-related impacts on business activities at manufacturing sites.

In 2021, the total water withdrawals used by TIP members in their operations increased by 4.7% compared to 2020 due to a 17.4% increase in production (Figure 7). Although production levels recovered to pre-pandemic values in 2021, total water withdrawals were considerably lower than in 2019. This was thanks to an increase in water efficiency, as the volume of water withdrawals per ton of production (i.e., the water intensity) decreased by approximately 10% compared to 2020. Reducing water withdrawals is a key objective

for TIP members; some have made important progress in reducing their water intensity by as much as 40% since 2009. They have achieved this through the implementation of water stewardship policies, including water preservation and conservation actions, such as water reuse and recycling (e.g., closed-loop cooling systems, evaporative cooling, rainwater harvesting, wastewater recycling); and leak detection.

Figure 7: TIP members' total water withdrawals and water intensity from 2009 to 2021



3.8 EXAMPLES OF WATER POLICIES AND PROJECTS

Reducing water withdrawals

Bridgestone has been recycling water at its Aiken Off Road Tire (AOR) plant in the United States through rainwater harvesting, where it collects rainwater from the plant's roof, cleans it and returns it to the plant for use in manufacturing. Thanks to this system, the AOR plant harvested more than 17 million liters of rainwater in 2021, reducing demand on the public water supply system.

In addition, **Bridgestone** has developed a water stewardship policy to help ensure that water is available on a socially equitable basis and the water cycle is preserved. The policy addresses water issues through a stakeholder-inclusive process that involves catchment-, site- and downstream-level actions. All manufacturing facilities in water-stressed areas are expected to implement water stewardship plans based on this policy by 2030.

In 2021, some of **Goodyear's** water efficiency projects included harvesting rainwater at its plant in Colombia. The company used the harvest water in its sanitary system, resulting in savings of 1,300 m³ of water over the course of the year. Another example was the reverse osmosis water treatment system installed at its Izmit plant in Turkey, which resulted in savings of 30,000 m³ of water and had an investment payback of less than six months.

Bridgestone reduced its water withdrawals and discharge at its S.A.I.C plant in water-stressed Argentina by partnering with cement manufacturer Loma Negra. Using a reverse osmosis water filtration system at its site, Bridgestone was able to recycle wastewater generated from its operations and provided Loma Negra with approximately 1,200 m³ of filtered water per month.

Wastewater recycling has also proven effective at reducing water withdrawals for other TIP members. For example, in 2021 **Michelin's** Phrapadaeng plant in Thailand reduced the daily

volume of water withdrawn and water discharged by 21% and 30% respectively through the installation of a reverse osmosis unit to treat and recycle wastewater.

Similarly, the **Goodyear** plant in Pulandian, China, implemented a project to reuse wastewater in cooling towers, saving up to 118 m³ of water per day.

Hankook is currently using 100% recycled water for its wet scrubbers at its plants in South Korea. Wet scrubbers are commonly used in industrial production to remove pollutants and particulate matter from flue gases before the latter are released into the atmosphere. It leverages the absorptivity of water to purify odors and gaseous pollutants. Last year, Hankook conducted a study to understand whether the use of recycled water impacted the efficiency with which pollutants were absorbed. The results showed that it did not, allowing the company to reach the target of using 100% recycled water.

Water withdrawal targets

Several TIP members have set targets to reduce their water withdrawals. **Hankook**, for example, aims to reduce its water intensity by 30% by 2030 compared to 2018. **Michelin** is committed to reducing its withdrawals per ton of finished and semi-finished product, weighted for water stress, by 33% by 2030

compared to 2019. **Pirelli** plans to reduce its water intensity by 43% by 2025 compared to 2015 and has already saved more than 14 million cubic meters of water thanks to its holistic facility management activities. **Sumitomo Rubber Group** is working to achieve 100% water recycled for high-risk sites by 2050. In 2021 **Goodyear**

already achieved its global water reduction target of 10% compared to 2020, 9 years ahead of schedule, and will set a new long-term goal to include legacy Cooper facilities. **Continental Tires** set targets to deliver a 20% reduction of water usage per output (m³/ton) by 2030, compared to 2020.

3.9 ISO 14001 COMPLIANCE

ISO 14001 is the leading international standard that outlines the requirements for environmental management systems (EMS) used by organizations to monitor and improve environmental performance.

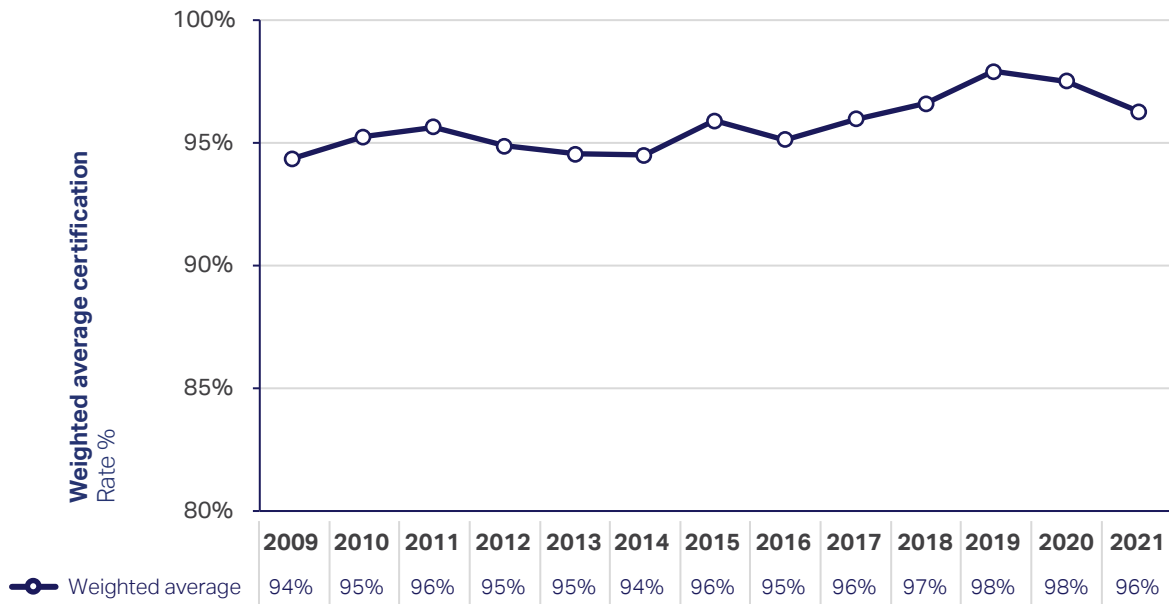
As seen in Figure 8 below, out of a total of 241 manufacturing sites operated by TIP members

in 2021, 232 or 96% were ISO 14001 certified. Compared to 2020, there was a slight decrease in the ISO 14001 certification rate, from 98% to 96%, reversing the upward trend in this indicator between 2009 and 2019.⁴ This slight drop in certification rate is explained by the fact that TIP members introduced three additional manufacturing sites in 2021 and did not receive their certification before the end of the reporting period.

More than half of TIP members reported that 100% of their sites were ISO 14001 certified and only nine sites were uncertified in 2021 across TIP members.

The high rate of certification showcases TIP members' commitment to continual improvement through this iterative process since EMS like ISO 14001 are based on the plan-do-check-act (PDCA) framework.

Figure 8: Weighted average certification rate: Number of ISO-14001 certified sites/total number of sites



3.10 EXAMPLES OF ENVIRONMENTAL MANAGEMENT POLICIES AND PROJECTS

Defining internal policies and plans

Several companies set targets for a 100% ISO 14001 certification rate at all (including new) production locations with some requiring the obtaining of certification within the first years of activity. Companies such as **Bridgestone** and **Goodyear** have expanded the scope of their EMS beyond individual manufacturing facilities to monitor performance at the global level, including across all customer-facing operations, like retail and field service support businesses.

In January 2021, **Toyo Tire** published its Global Environmental Policy, which sets out the philosophy and guidelines behind its strategy to contribute to the SDGs and to operate with respect for the environment. According to this policy, once set, an environmental subcommittee reviews the targets and action plans annually against progress on them and provides guidance for improvement when necessary. The policy will support international norms and, through precautionary approaches, will involve all players in the value chain in the mitigation of environmental impacts.

Sumitomo Rubber Group published its long-term sustainability plan in August 2021. *Driving Our Future Challenge 2050* stipulates the company's 2050 targets with regards to the environment, society and governance, as well as the intermediary targets and actions that will

contribute to reaching the long-term targets. With respect to its environmental performance, particularly noteworthy are Sumitomo Rubber Group's goal to reach carbon neutrality by 2050 and reduce emissions by 50% by 2030 compared to 2017; its target of using 40% sustainable raw materials by 2030 and 100% by 2050; and its commitment to using 100% recycled water at sites in areas with high and critical levels of water stress.

Michelin switched to a new internal environmental performance indicator in 2021 to track and measure its progress in the decade to 2030 in five main environmental areas: (1) energy consumption; (2) CO₂ emissions; (3) consumption of organic solvents; (4) water withdrawals from water stressed areas; and (5) the amount of waste generated. The I-MEP indicator, which stands for Industrial Michelin Environmental Performance, will help the company ensure that it reduces its CO₂ emissions by 25% between 2019 and 2030. To get there, Michelin will: (i) electrify processes; (ii) improve the performance and control of tire curing equipment and motor drives; (iii) increase the efficiency of steam, compressed air and cooling; and (iv) install new heat pumps. The company is in the process of translating the corporate-level targets into roadmaps for each production site.

Goodyear has implemented an integrated EHS governance approach for continuous EHS improvement, whereby

objectives cascade from senior leadership to regions and then to local facility teams, which are accountable for strategy execution. Goodyear's EHS Governance Council ensures that the strategy is aligned across regional teams.

Hankook has digitalized environmental facility management at a manufacturing plant that previously depended on offline documentation and verbal communication. This included the adoption of a QR-code system to support real-time data sharing and efficient documentation of on-site inspections. The system enables real-time communication between field-operation staff and managers and QR codes allow users to check on the status of facilities using their mobile phones.

Pirelli launched an Industrial Plan in 2021 that stipulates sustainability targets for 2025-2030. The company defined the targets based on its material impacts on the economy, society and environment and aligned them with the UN Sustainable Development Goals. Pirelli based the Industrial Plan on its Eco & Safety approach, which aims to maximize environmental performance while ensuring safety and promoting a circular economy, particularly by reducing resource use.

Raising environmental awareness through training

Michelin has rolled out dedicated training courses to support the deployment of its EMS at certified sites. These training programs have targeted more than 75,000 employees, including subcontractors and temporary workers, and

have contributed to raising environmental awareness across Michelin's facilities.

In 2021, **Goodyear's** associates completed a total of 21,486 e-learning courses offered through the Plant Optimization Academy – the company's

manufacturing operating system, which is built on the foundation of People and Environmental Care (PEC). This represented an increase in completed courses of 5.2% compared to 2020 and 59% compared to 2019.

Working along the value chain

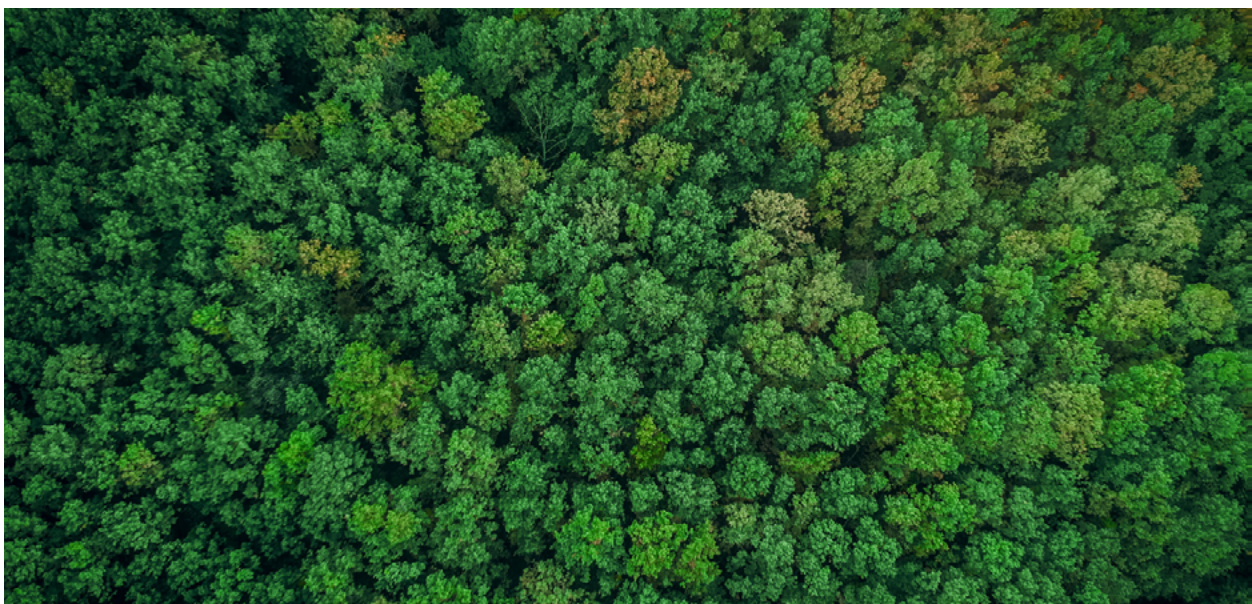
Continental has entered into a partnership with the German development aid agency Deutsche Gesellschaft für internationale Zusammenarbeit (GIZ) to improve the sustainability of the natural rubber supply chain in Indonesia, which is the world's second largest producer of natural rubber. The partnership aims to develop a catalogue of criteria for the sustainable production of natural rubber, to train farmers according to these criteria, and to increase traceability in natural rubber

supply chains. The initiative, part of the develoPPP.de program initiated by the German Federal Ministry for Economic Cooperation and Development (BMZ), aims to improve rubber quality and supply chain optimization while generating higher incomes for rubber tree cultivators.

In collaboration with Kordsa, a specialist in reinforcement technologies, **Continental Tires** launched a new sustainable adhesive technology, called Cokoon, in 2020. This new technology

enables the bonding activation of textile-reinforcing materials with rubber compounds without the use of resorcinol and formaldehyde in the textile dip, reducing the potential environmental impact of this stage of the tire manufacturing process.

Kumho Tire is working on R&D to develop new sustainable tire ingredients using natural materials such as sunflower oil and rice bran silica, as well as recycled materials such as rubber and carbon black.



3.11 WASTE

The two main types of waste resulting from the manufacturing of tires are (i) downgraded manufacturing waste, which is essentially the scrap resulting from production and comprises elastomers, non-compliant tires and others; and (ii) industrial waste, including sludges, electrical equipment and packaging, among others.

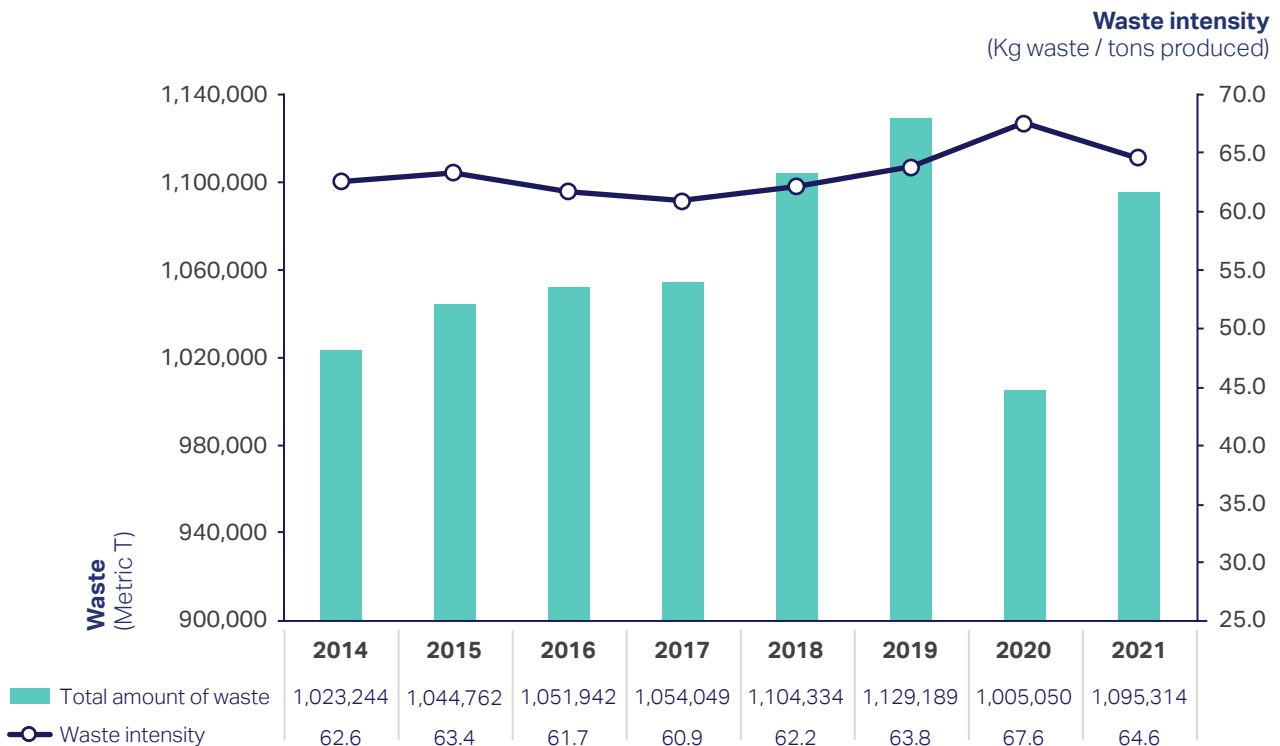
TIP members are committed to reducing waste, which is reflected in this report with the inclusion of a new KPI that discloses the amount of waste generated by TIP members' operations. It is worthwhile to note that we measure the total amount of waste produced, as

disclosed in this report, in metric tons and that this indicator covers waste produced at both the offices and production plants of TIP members. This goes beyond the scope of the other four indicators focused only on manufacturing facilities. The waste indicator includes the total waste generated from all industrial and administrative activities, as well as food waste from on-site catering facilities and waste electrical and electronic equipment (WEEE). It does not include construction and demolition waste.

Figure 9 maps out data regarding the total amount of waste generated and waste intensity starting in 2014. Overall, the total amount of waste generated

has been on an upward trend, increasing by 10% in absolute terms between 2014 and 2019. The steep drop in production in 2020 compared to 2019, a result of the COVID-19 pandemic, was also accompanied by an 11% decline in the absolute amount of waste produced. In 2021, as production returned to pre-pandemic levels, so did the total amount of waste generated. The waste intensity was more stable in the period from 2014 to 2021, increasing slightly from 62.6 to 64.6 kg of waste per ton produced. The peak in waste intensity observed in 2020 is explained by low production values resulting from the COVID-19 pandemic, while facilities remained open and continued to generate waste.

Figure 9: TIP members' total waste generated and waste intensity from 2009 to 2021



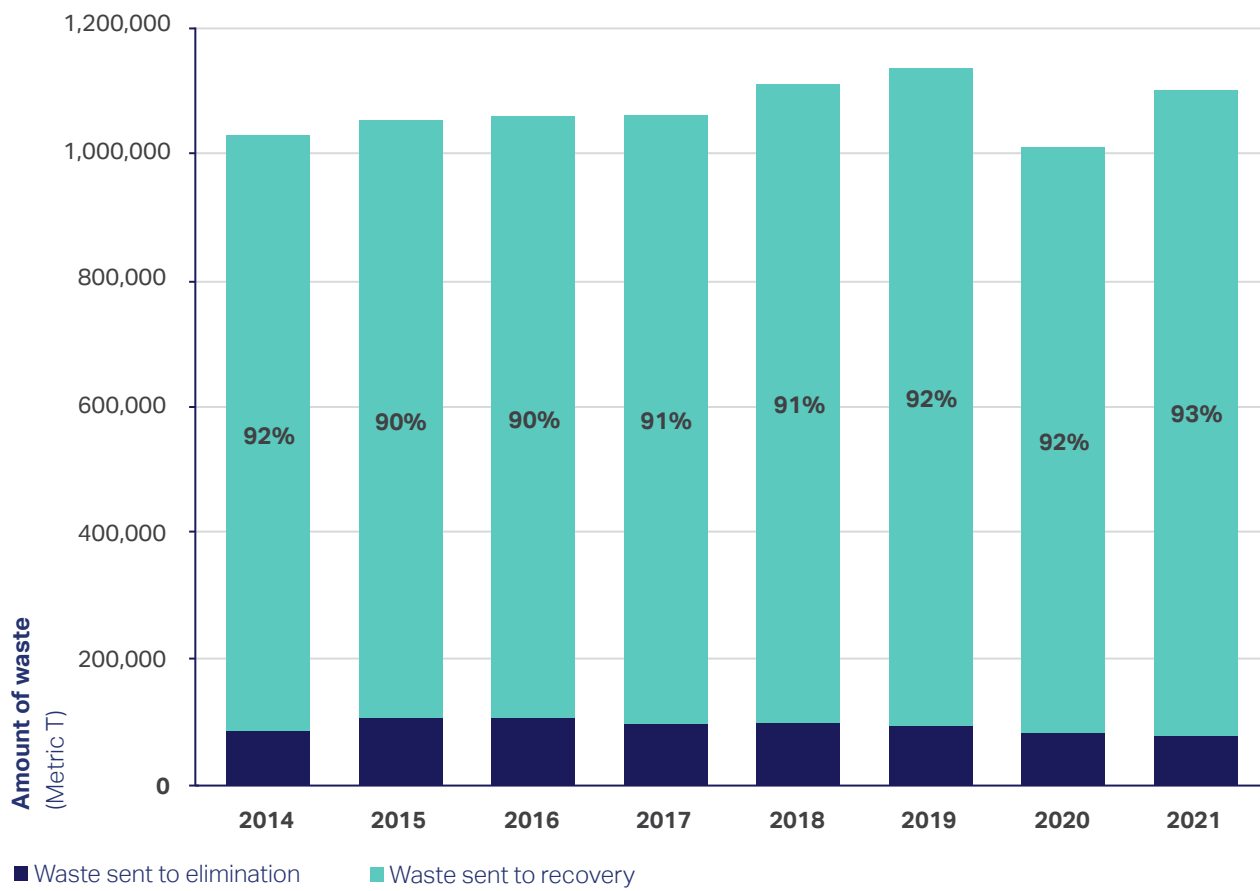
It is also important for companies to understand how they manage waste. Therefore, TIP members have been tracking and monitoring the total weight of both recovered and eliminated waste. Recovered waste describes waste prepared for reuse or recovery, recycled,

composted or incinerated with energy recovery. Eliminated waste describes waste incinerated without energy recovery or landfilled.

Figure 10 shows that TIP members have consistently recovered the vast majority of

the waste generated over the years. In 2014, they recovered 91.7% of the total waste generated; by 2021, they recovered 92.33% of the total waste generated.

Figure 10: Breakdown of waste sent to elimination and recovery



3.12 EXAMPLES OF WASTE POLICIES AND PROJECTS

In order to reduce their operational waste, TIP members have pursued a number of different strategies, including the development of new recycling technologies and the promotion of reuse and recovery of operational waste, for example:

Bridgestone has developed a recycling technology for waste oil at its Kurume Plant in Japan that is expected to lead to the reduction of 100 tons of waste oil annually.

Hankook has been trialing the reuse of waste oil as dust-seal oil and hydraulic oil – both of which are in high demand at Hankook facilities.

Yokohama aims to use more than 30% renewable and recycled raw materials by 2030 and 100% by 2050. The company is currently working, together with partners in academia and industry, to develop synthetic rubber materials (butadiene and isoprene) from biomass rather than fossil fuels.

Goodyear established a zero-waste-to-landfill (ZWTL) goal at its tire and chemical manufacturing plants in 2006. Since then, the company has worked to improve its waste management practices by putting in place corporate standards, processes and systems to ensure the appropriate disposal of waste. Goodyear has been monitoring waste generation through reports differentiated by waste types and means of disposal and has developed a detailed waste-vendor approval process. The company requires its waste management operators to comply with its ZWTL program and monitors and audits performance to ensure compliance. If the company observes any deviations from the program, it takes immediate action, which can include corrective action plans or the termination of vendor contracts.

Pirelli developed tires made with materials of which 94% were of non-fossil or recycled origin, such as silica from rice husks and bio-resins.

This concept has paved the way for the introduction of innovative sustainable materials in the normal production of selected Pirelli product lines. Notably, the percentage of renewable materials increased from 23% to 28% between 2020 and 2021 and the ratio of recycled materials reached 5%.

Michelin is taking several steps to reduce operational waste, including the increased reuse of materials, exploring new recovery and reuse routes, raising employee awareness, and reviewing end-of-waste criteria. In 2021, the company generated 33.3 kg of operational waste per ton of finished and semi-finished product, this represented an improvement of 7.5% compared to 2019. In absolute terms, in 2021, the company was able to reduce the amount of waste generated by 5% compared to 2019.

④ Conclusion



4 Conclusion

4.1 HOW TIP MEMBERS HAVE IMPROVED THE ENVIRONMENTAL PERFORMANCE OF THEIR MANUFACTURING OPERATIONS

TIP members continue to draw on new methods and technologies to improve the

environmental performance of their manufacturing operations, including the implementation of energy-efficient management systems and machinery, the adoption of renewable and low-carbon energy mixes, processes to improve water-use efficiency, and initiatives to reduce operational waste.

Summarized below are the main examples of initiatives and projects undertaken by TIP members that have directly contributed to improvements in the environmental performance of their tire manufacturing operations.

Initiatives to improve energy efficiency and reduce CO₂ emissions

- Optimization of compressed air systems
- Development of cross-functional governance bodies focused on sustainability
- Establishment of a decarbonization task force
- Increased electrification of processes
- Improved performance and control of tire curing equipment and motor drives
- Increased efficiency for steam generation, compressed air and cooling
- Installation of new heat pumps
- Development of internal environmental performance indicators to track and measure progress in energy consumption and CO₂ emissions
- Installation of solar or photovoltaic panels
- Implementation of electricity supply agreements and the purchase of energy attribute certificates in order to ensure the procurement of 100% renewable electricity
- Switching from natural gas to green hydrogen in the production of steam

Methods for improved waste efficiency

- Development of recycling technology for waste oil
- Researching new recovery channels
- Employee awareness-raising projects highlighting the importance of waste reduction
- Implementation of corporate standards, processes and systems to ensure the appropriate disposal and increased monitoring of waste and materials
- Development of detailed waste vendor approval process requiring waste subcontractors to comply with zero-waste-to-landfill programs
- Use of recycled carbon black for tire manufacturing

Methods for improved water-use efficiency

- Development and implementation of policies for the responsible use of water
- Assessment of water stress levels within the catchment area of manufacturing plants and identification of water-related impacts on business activities around manufacturing sites
- Increased use of rainwater harvesting
- Set-up of reverse osmosis water filtration systems for the recycling of wastewater
- Reuse of wastewater in cooling towers
- 100% use of recycled water in wet scrubbers
- Implementation of evaporative cooling to capture process-water and steam condensate to reuse water and reduce its use

4.2 FUTURE EDITIONS OF THE TIP KPI REPORT

As highlighted in the Introduction, the TIP is working to integrate additional SDG-aligned indicators in the next edition of this report in line with the WBCSD's **Sustainability Driven: Accelerating Impact with the**

Tire Sector SDG Roadmap report. Indeed, while data on the environmental performance of tire manufacturing operations will continue to be an important part of reporting on TIP member contributions to the SDGs, we understand that monitoring the progress of companies across the whole tire life cycle and their

implementation of the roadmap will be important to ensuring that the sector remains focused on optimizing its contributions to the SDGs. For this reason, the roadmap and the SDG targets most relevant to the tire life cycle (Figure 11) will provide important reference for any additional expansion of TIP KPI reporting.

Figure 11: The impact opportunities identified by the SDG Roadmap for the tire sector and their relevant SDG target

		IMPACT OPPORTUNITY AREA							
		 Supply chain		 Operations		 Products & services			
IMPACT OPPORTUNITY FOCUS	Natural rubber sustainability		Responsible sourcing		Operations, incl. manufacturing	Employees	Tire and road wear particles (TRWP)	Sustainability mobility and digital solutions	Low-carbon, circular solutions and end-of-life tires (ELT)
	RELEVANT SDG TARGETS AS IDENTIFIED IN THE ROADMAP*	 4.5  8.4  12.2	 8.4  12.2  12.6	 6.4  9.4  12.2	 5.5  10.3  10.4	 12.4  12.6	 3.6  9.5  12.2  1.8	 8.4  12.2  12.5	

*SDG targets are relevant to both TIP and TIP member actions

Discover more about TIP members' contributions to sustainable development

Bridgestone

<https://www.bridgestone.com/responsibilities>

Continental

<https://www.continental.com/en/sustainability>

Goodyear

<https://corporate.goodyear.com/en-US/responsibility.html>

Hankook

<https://www.hankooktire.com/global/en/esg/hankook-tire-esg/esg-overview.html>

Kumho Tire

http://www.kumhotire.com/eng/company/ManagementPolicy_061.asp
(Korean)

Michelin

<https://www.michelin.com/en/sustainable-development-mobility>

Pirelli

<https://corporate.pirelli.com/corporate/en-ww/sustainability/sustainability>

Sumitomo Rubber

<https://www.srigroup.co.jp/english/sustainability/index.html>

Toyo Tire

<https://www.toyotires-global.com/csr/>

Yokohama Rubber

<https://www.y-yokohama.com/global/csr/>



Appendix

METHODOLOGICAL NOTE

ENTITIES AND SCOPE OF REPORTING

dss+ collected the 2021 data presented in this report on behalf of TIP. The reporting scope includes all the sites under TIP members' operational control, namely 241 sites in 2021. The data is consolidated at 100% for all entities under operational control (regardless of the financial consolidation rate). The following premises and activities are included in the reporting scope: tire manufacturing

sites and all related on-site activities (canteen, R&D, mixing, bladder production, reused tire processing, etc.) and stand-alone sites with mixing activities. Other stand-alone sites (bladder production, steel cord, textile facilities, retread tire processing, HQ, offices, etc.) are excluded. Offices are included in scope for the waste indicator.

Data was collected on an individual-company basis, which was later aggregated by dss+. A series of data quality checks was carried out between dss+ and TIP members to ensure data quality

and consistency with previous reporting years. The aggregated data was used to produce the figures and tables included in this report.

Due to new acquisitions, greenfield sites or shutdowns, the reporting scope and the number of sites participating in the reporting is not constant over time.

The qualitative information reported is not exhaustive and the implementation of measures can vary both among and within companies.



INDICATOR DEFINITIONS

All indicators were evaluated using the TIP Common Methodology. The Common Methodology is a reporting protocol that defines the indicators, scope and calculation methodology. The Common Methodology was set up and agreed upon by TIP members and is summarized below.

Energy consumption: The energy consumption from different sources (e.g.: electricity, gas, renewables) is consolidated in net calorific value (NCV) and measured in gigajoules (GJ). The electricity and steam sold to external third parties are deducted. Fuel consumption related to off-site transportation (employees, products) is excluded.

Data regarding electricity consumption was collected using the location-based method. This approach reflects the average emissions intensity of the grid, using a grid-average emissions factor.

Energy intensity is weighted by production and is calculated by dividing the total energy consumed (in GJ) by the total production (in tons) in the same year.

Sources of emissions factors: Scope 1 emissions factors: 2006 Intergovernmental Panel on Climate Change (IPCC) guidelines for stationary combustion in the manufacturing industry. Scope 2 emissions factors associated with electricity purchases: International Energy Agency (IEA) Emissions Factors (2022).

CO₂ emissions are calculated by multiplying each energy source by its corresponding emissions factors (2006 IPCC guidelines

for scope 1, IEA CO₂ emissions factors for scope 2).

CO₂ intensity is weighted by production, which is calculated by dividing the total CO₂ emitted (in tons of CO₂ equivalent) by the total production (tons) during the same year.

Water withdrawals: Water withdrawals represent the net amount of water entering the sites and withdrawn from any external source (pumping from natural resources, public networks, recycled water from external companies or from desalination plants, etc.). All external sources of water withdrawals used for industrial, cooling and domestic use are taken into consideration, including the amount of water sold to off-site third parties or consumed by third-party companies on-site.

Water intensity is weighted by production and is calculated by dividing the total water withdrawals by the total production (in tons) in the same year.

ISO 14001: The certification rate has been calculated by dividing the total number of sites with ISO 14001 certification by the total number of sites. A site is recognized as being ISO 14001 certified during a given calendar year only if an external certificate is valid on 31 December of that year.

Production is calculated as the weight of intended products to be sold to end-users as an output of the production lines, as well as the weight of new materials integrated in retread tires if this activity is in scope for the tire manufacturing plant.

Waste: Unlike the other indicators, waste data was collected starting from 2014. Disaggregated data was collected according to the disposal type (recovery and elimination), depending on the availability of the data. Waste is defined as all material generated unintentionally during production, not resulting in a finished product on-site and legally considered as waste. Waste generated on-site by third parties (working within the physical perimeter of the facilities but not operated by a TIP company) is included in scope for this indicator. The following are considered waste for the purposes of this report: office waste, waste electrical and electronic equipment (WEEE) from production sites and offices, sludges, defect tires never going back into the production chain, food waste resulting from canteens or restaurants on site, and hazardous wastewater removed by a third party.

Waste intensity is weighted by production and is calculated by dividing the total amount of waste generated (in metric tons) by the total production (tons) in the same year.

Endnotes

¹ Statista (2022). Retail price of regular gasoline in the United States from 1990 to 2021. <https://www.statista.com/statistics/204740/retail-price-of-gasoline-in-the-united-states-since-1990/>

² Gfanz (2021). Amount of finance committed to achieving 1.5 now at scale needed to deliver the transition. <https://www.gfanzero.com/press/amount-of-finance-committed-to-achieving-1-5c-now-at-scale-needed-to-deliver-the-transition/>

³ ETRMA (n.d.). The Natural Rubber Supply Chain. <https://www.etrma.org/key-topics/materials/natural-rubber/>

⁴ Note that the 2020 value for total number of sites reported in last year's TIP report (242) differs from the value reported here (240 sites) as two members changed their number of sites in 2020.



ABOUT THE TIRE INDUSTRY PROJECT (TIP)

TIP - currently comprised of 11 leading tire companies - is the primary global forum for the tire industry on sustainability issues. Formed in 2005, TIP serves as a global, voluntary, CEO-led initiative representing more than 60% of the world's tire manufacturing capacity. Its aim is to proactively identify and study the potential human health and environmental impacts associated with the life cycle impacts of tires to proactively contribute to a more sustainable future. Discover more about TIP: www.wbcسد.org/tip.

ABOUT WBCSD

WBCSD is the premier global, CEO-led community of over 200 of the world's leading sustainable businesses working collectively to accelerate the system transformations needed for a net zero, nature-positive, and more equitable future.

We do this by engaging executives and sustainability leaders from business and elsewhere to share practical insights on the obstacles and opportunities we currently face in tackling the integrated

climate, nature and inequality sustainability challenge; by co-developing "how to" CEO guides from these insights; by providing science-based target guidance including standards and protocols; and by developing tools and platforms to help leading businesses in sustainability driven integrated actions to tackle climate, nature and inequality challenges across sectors and geographical regions.

Our member companies come from all business sectors and all major economies, representing a combined revenue of more than USD \$8.5 trillion and 19 million employees. Our global network of almost 70 national business councils gives our members unparalleled reach across the globe. Since 1995, WBCSD has been uniquely positioned to work with member companies along and across value chains to deliver impactful business solutions to the most challenging sustainability issues.

Together, we are the leading voice of business for sustainability, united by our vision of creating a world in which 9+ billion people are living well, within planetary boundaries, by mid-century.

www.wbcسد.org.

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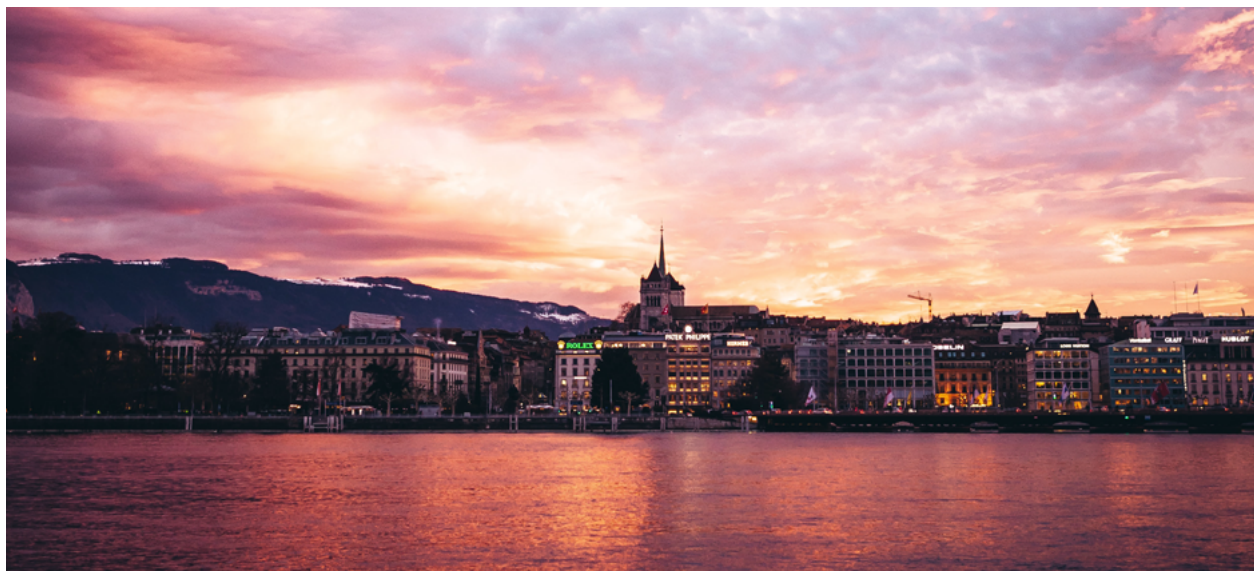
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