# Scrap Tire Recovery and Recycling in Ontario, 2019–2023

## CATRA 2021 Scrap Tire Life Cycle Assessment
## Year-over-year update 2024

Scope 3 Consulting, LLC

for CATRA / eTracks

scope3@scope3consulting.com

October 10, 2024

SCOPE 3 CONSULTING

# Contents

# 1 Introduction

End-of-life tires are one of the largest waste streams in Canada. Responsible management of end-of-life tires can provide significant environmental benefits by reducing demand for new materials and energy, and also avoiding landfill waste.

For the past five years, the Canadian Association of Tire Recycling Agencies (CATRA) and Scope 3 Consulting have worked together to create an ongoing study of the life-cycle benefits of scrap tire management. This document reports the material flows and environmental impacts and benefits of scrap tire management in Ontario during 2019–2023.

## 1.1 About Scope 3 Consulting

We are experienced sustainability professionals with a dedication to preparing accurate and useful environmental footprint studies for firms, industry groups and public agencies throughout the United States and Canada. We believe in empowering decision makers with credible information presented clearly and concisely. Our Antelope software is an engine for creating powerful and responsive life cycle assessment and circularity studies.

Scope 3 Consulting LLC is based in Santa Barbara, California, USA.

## 1.2 Study Basis

This report is based on a *material flow analysis* (MFA) of scrap tires and tire-derived products collected and managed under the scrap tire management program operated by eTracks. The MFA uses primary data provided by the agency, as well as statistics published by the Resource Productivity & Recovery Authority (RPRA), to estimate the quantity of scrap tires under management, their origins, processing locations, and ultimate fates. The MFA results are coupled to a *life cycle model* that is used to generate estimates of environmental impact. The life cycle model was based on a life cycle assessment (LCA) study commissioned by CATRA in 2019. The final study report was critically reviewed according to ISO 14044, and was released in July 2022.

A previous *provincial report* was prepared for eTracks which included provincial statistics through 2019 and eTracks data for 2020. The present report extends the study timeline through the year 2023 with updated data provided by eTracks. For further details and documentation of the study background and methodology, please consult the study report. For prior year provincial results, please consult the provincial report.

## 1.3 2024 Core Model Update

In 2024, the life cycle model was revised to use the most up-to-date data sources. In the update, most of the 108 system models in the study underwent some changes to the results, but for the most part these changes were minimal in magnitude. Electricity grids generally got greener, but most other activities saw small increases in impact scores. This is due to the trend toward increased completeness in the background databases that were the center of the upgrade. Truck transportation models were revised, leading to slightly higher impacts across the board for transportation. These results were driven by increases in the upstream life cycle impacts for the truck processes, especially diesel fuel production and truck manufacture. Many displaced activities also saw their impact scores increase in the update. Since these scores are subtracted from the incurred scores, they tended to offset the increases in incurred impacts. Consequently, most provincial KPIs saw little change as a result of the update.

The updated data sets did enable us to add a water footprint impact indicator to the study (see Section 4.2). Further details about the model update will be provided in an annex to the Study Report later this year. The results of the core model update have not been critically reviewed.

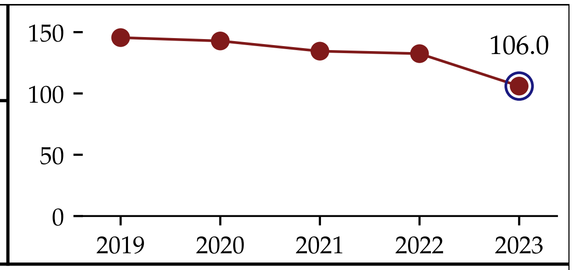
# 2 Key Performance Indicators

## 2.1 Total Processing

**TIRES PROCESSED - ON**

thousand metric tonnes (kt)

| | | |
|---|---|---|
| Value for 2023 | 106.0 | kt |
| Change since 2022 | -20.0 | % |
| Change since 2019 | -27.2 | % |
| Total | 661.3 | kt |




This is the amount of tires that enter processing in the province in a given year

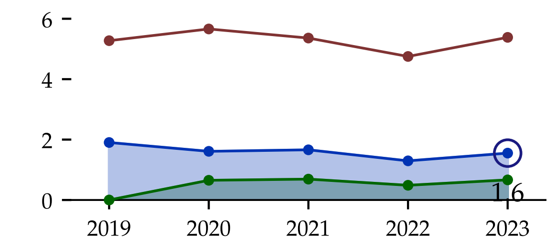
This chart shows the total amount of tires that were converted to products within the eTracks program during the years 2019–2023. This includes tires from collection, as well as stock drawdown. The data supplied by eTracks showed a substantial reduction in scrap tire collections under the program in 2023 compared to prior years. Overall the trend was downward, but 2023 showed a 20% reduction in collections since 2022. This may be partially due to changes in accounting and data processing (see Section 3).

## 2.2 Incurred Impacts

**INCURRED EMISSIONS - ON**

Global Warming Intensity (kg CO2e/PLT)

| | | |
|---|---|---|
| Reverse Logistics, 2023 | 0.7 | kg CO2e/PLT |
| add Processor emissions, 2023 | 1.6 | kg CO2e/PLT |
| add downstream, 2023 | 5.4 | kg CO2e/PLT |




Emissions intensity of all activities that occur during scrap tire collection (shaded green), processing (shaded blue), and downstream production (unshaded, includes further processing and transport to market). Values are reported per PLT-equivalent (10.5 kg) processed. Reported values include both direct and indirect emissions.

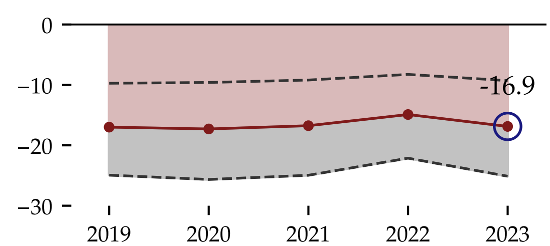
Incurred emissions are generated during collection and processing of scrap tires, as well as during further processing of tire-derived materials to make them into products. This chart shows global warming potential (GWP) impacts on a per-tire basis. These emissions can be attributed to the operation of the scrap tire management program in Ontario, and represent the environmental cost of operating the program. Incurred impacts at the processor were mostly level, while downstream impacts slightly increased, on a per-PLT basis. Processor impacts included facility electricity and fuel use for crumbing and retreading operations. Downstream impacts were dominated by processing for molded products, and by limited combusion of tire-derived wastes. Note that no reverse logistics estimation was available for 2019.

## 2.3 Avoided Impacts

**AVOIDED EMISSIONS - ON**

Global Warming Intensity (kg CO2e/PLT)

| | | |
|---|---|---|
| Value for 2023 | -16.9 | kg CO2e/PLT |
| Change since 2022 | +13.2 | % |
| Change since 2019 | -0.7 | % |
| Average, Avoided Emissions | -16.6 | kg CO2e/PLT |




Emissions intensity of all activities expected to be displaced through the marketing of scrap tire-derived products. Red shaded area indicates median range; dashed lines indicate uncertainty with respect to modeled displacement rate.

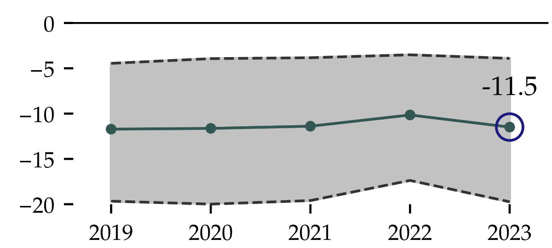
Potentially avoided emissions report the impact of producing goods and services that compete with tire-derived products in the marketplace. Under the assumption of displacement, some competing products were not produced because of the availability of tire-derived alternatives. Avoided impacts are shown as a negative score with an uncertainty range (see discussion of displacement uncertainty in Section 4.1). The mix of products derived from scrap tires managed by eTracks tends to be higher value, because production of low-value goods such as TDA and TDF are not incentivized. Avoided emissions were driven by primary rubber products, mineral-based turf infill, and reduced requirements for roadway construction and maintenance attributable to the use of rubber-modified asphalt.

## 2.4 Net Impacts

**NET EMISSIONS - ON**

Global Warming Intensity (kg CO2e/PLT)

| | | |
|---|---|---|
| Value for 2023 | -11.5 | kg CO2e/PLT |
| Change since 2022 | +13.2 | % |
| Change since 2019 | -1.9 | % |
| Average, Net Emissions | -11.3 | kg CO2e/PLT |




Estimated net environmental impact resulting from incurred and potentially avoided activities. A negative value indicates a potential environmental benefit. The net total is shown as the blue line, with the uncertainty due to modeled displacement rate shown by the dashed lines and shaded region.

Net emissions report the combination of (positive) incurred and (negative) avoided emissions. The study results indicate that scrap tire management led to substantial reductions in environmental impacts through the displacement of primary production by tire-derived products. Net emissions per PLT-equivalent became slightly more negative in 2023 due to an increased share of crumb and reduced share of TDF in the product mix.

## 2.5 KPI Table

Table 1 on the next page reports impacts across all six indicators measured for the study, over the time period 2019–2023. Impacts are reported on both per-PLT-equivalent and Provincial basis. The net impact scores in three categories are also reported in terms of *equivalency factors*, which are meant to be more tangible and easy to understand:

- **Private vehicle travel–** net global warming impacts are compared to the use of a private vehicle weighing approximately 1,600 kg and having a fuel economy of 28.5 miles per gallon / 46 km per gallon / 8.2 liters per 100 km.
- **Diesel loader operation–** net smog impacts are compared to the operation of a 100 hp diesel loader for one hour at a low duty cycle (1.8-2 gal/hr).
- **Coal-fired electricity–** net particulate impacts are compared to the combustion of one kg of coal in a power plant to generate electricity.

For each of these impact categories, the net total impact scores (under the median displacement assumption) for scrap tire management are described in terms of the equivalency. If the net impacts are negative, the effect of the program is comparable to *avoiding* the reported amounts of each activity. *(Note: these different equivalencies are for comparison purposes only, and are not cumulative with each other.)*

Table 1: Tabulated KPI Scores for Ontario.

| Indicator | unit | 2021 | 2022 | 2023 | 5 year |
|---|---|---|---|---|---|
| Global Warming Air | | | | | |
| Facility Impacts (per PLT eq) | kg CO2 eq | 0.97 | 0.81 | 0.89 | 1.08 |
| Total Incurred Impacts (per PLT eq) | kg CO2 eq | 5.36 | 4.75 | 5.38 | 5.30 |
| Net Impacts (per PLT eq) | kg CO2 eq | -11.39 | -10.15 | -11.49 | -11.44 |
| Net Impacts (Provincial) | kt CO2 eq | -145.9 | -128.1 | -116.0 | -706.6 |
| Equivalency (negative = avoided) | | | | | |
| Private vehicle travel | billion km | -0.431 | -0.378 | -0.342 | -2.087 |
| 1600 kg vehicle; Equivalent to 28.5 mpg \| 46 kpg \| 8.2 l/100km fuel economy | | | | | |
| Smog Air | | | | | |
| Facility Impacts (per PLT eq) | g O3 eq | 64.1 | 58.1 | 60.4 | 70.5 |
| Total Incurred Impacts (per PLT eq) | g O3 eq | 357.4 | 321.0 | 361.1 | 353.4 |
| Net Impacts (per PLT eq) | g O3 eq | -647.3 | -580.0 | -659.3 | -638.3 |
| Net Impacts (Provincial) | kt O3 eq | -8.291 | -7.317 | -6.656 | -39.429 |
| Equivalency (negative = avoided) | | | | | |
| Diesel loader operation | million hour | -4.56 | -4.02 | -3.66 | -21.69 |
| 100 hp diesel engine with low load factor, 1.8-2 gallons per hour | | | | | |
| Human Health Particulates Air | | | | | |
| Facility Impacts (per PLT eq) | g PM2.5 eq | 0.593 | 0.485 | 0.532 | 0.683 |
| Total Incurred Impacts (per PLT eq) | g PM2.5 eq | 2.792 | 2.447 | 2.771 | 2.776 |
| Net Impacts (per PLT eq) | g PM2.5 eq | -8.372 | -7.468 | -8.437 | -8.314 |
| Net Impacts (Provincial) | t PM2.5 eq | -107.2 | -94.2 | -85.2 | -513.6 |
| Equivalency (negative = avoided) | | | | | |
| Coal-fired electricity | million kg | -96.5 | -84.8 | -76.7 | -462.3 |
| Burning 1 kg of coal in a typical coal power plant | | | | | |
| Acidification Air | | | | | |
| Facility Impacts (per PLT eq) | g SO2 eq | 4.02 | 3.48 | 3.71 | 4.49 |
| Total Incurred Impacts (per PLT eq) | g SO2 eq | 21.13 | 19.17 | 21.38 | 21.29 |
| Net Impacts (per PLT eq) | g SO2 eq | -47.96 | -43.32 | -49.03 | -47.37 |
| Net Impacts (Provincial) | t SO2 eq | -614.3 | -546.5 | -495.0 | -2926.1 |
| Ozone Depletion | | | | | |
| Facility Impacts (per PLT eq) | mg CFC-11 eq | 0.389 | 0.331 | 0.368 | 0.417 |
| Total Incurred Impacts (per PLT eq) | mg CFC-11 eq | 3.434 | 3.045 | 3.471 | 3.335 |
| Net Impacts (per PLT eq) | mg CFC-11 eq | -2.195 | -1.337 | -1.421 | -3.067 |
| Net Impacts (Provincial) | kg CFC-11 eq | -28.1 | -16.9 | -14.3 | -189.5 |
| Eutrophication Air + Water | | | | | |
| Facility Impacts (per PLT eq) | g N eq | 2.37 | 1.98 | 2.17 | 2.67 |
| Total Incurred Impacts (per PLT eq) | g N eq | 7.89 | 6.80 | 7.75 | 7.87 |
| Net Impacts (per PLT eq) | g N eq | -23.46 | -21.61 | -24.07 | -23.47 |
| Net Impacts (Provincial) | t N eq | -300.5 | -272.7 | -243.0 | -1449.9 |
| Blue water depletion | | | | | |
| Facility Impacts (per PLT eq) | m3 | 0.0793 | 0.0685 | 0.0786 | 0.082 |
| Total Incurred Impacts (per PLT eq) | m3 | 0.13 | 0.114 | 0.131 | 0.131 |
| Net Impacts (per PLT eq) | m3 | -0.525 | -0.471 | -0.542 | -0.528 |
| Net Impacts (Provincial) | m3 | -6.72e+06 | -5.94e+06 | -5.48e+06 | -3.26e+07 |

# 3 Scrap Tire Material Flows

We obtained detailed data about the collection and processing of scrap tires from eTracks. We used this information to calculate the flow of scrap tires and tire-derived materials from the points of collection, through processing, to final products.

During 2019, minimal information was available about scrap tire management in the province; however, a report from RPRA was used to establish the quantity and nature of tire-derived products. Beginning in 2020, more complete information was available from eTracks. Data provided by the agency report activities related to tire management in terms of transactions between a “source” and a “target.” Depending on the type of transaction, each record may indicate collection, delivery to a processor, disposition, or retreading.

Deliveries are reported by processor and tire type. Disposition is reported in terms of a 5-tier scale in which TDP1, TDP2, and TDP3 describe various grades of crumb rubber; TDP4 reports fabricated products, and TDP5 reports tire-derived shred or aggregate. Culling of tires for reuse, scrap steel, and disposal of tire-derived wastes to landfill or energy recovery is also reported. Reports on retreading operations include tire type as well as recovery yield. A Sankey diagram showing reported scrap flows for 2023 is found in Figure 1.

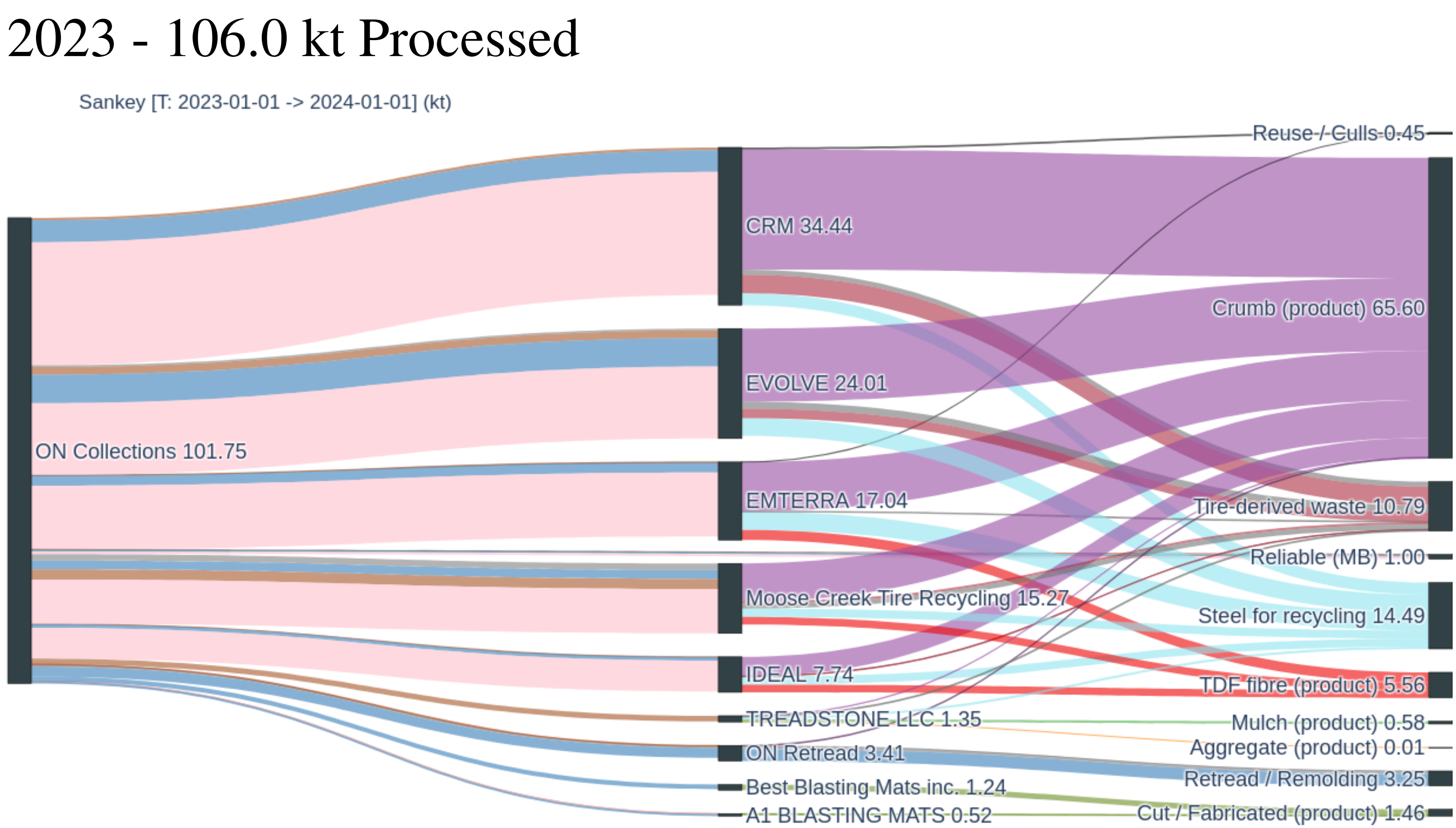


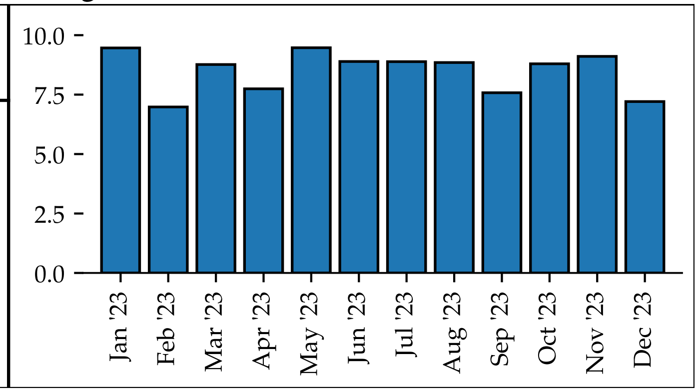

Figure 1: Scrap tire flows for 2023 as a Sankey diagram. On the collection side, pink stripes correspond to PLT, blue stripes indicate MT, brown stripes indicate all types of smaller OTR, and grey strips indicate large and giant OTR.

## 3.1 Focus on 2023

Monthly charts of tire collections, freight, and processor activity are shown below. The charts show a gradual downward trend of freight requirements, against a more consistent level of collections per month. This suggests that tires are being collected closer to their eventual destinations.

**COLLECTIONS**
Mixed Tires - ON (kt)

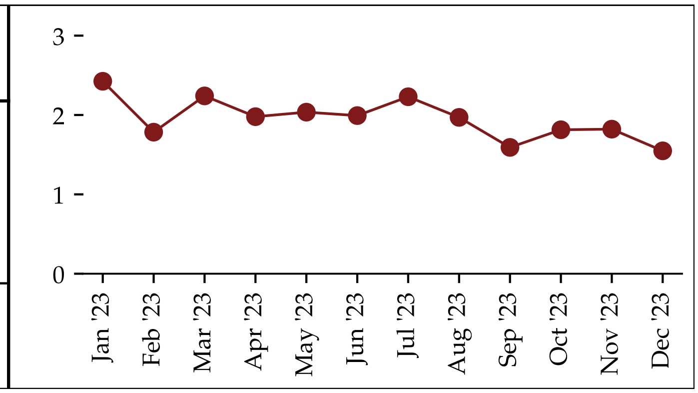
Total 101.7 kt




**TOTAL FREIGHT**
Mixed Tires - SK ($10^6$ t*km)

Total 23.4 $10^6$ t*km

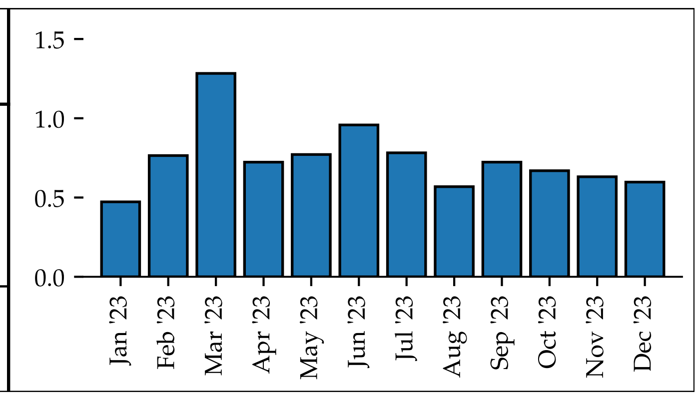
Total freight requirements, across all transport modes, to all destinations




**PROCESSOR IMPACTS**
Global Warming Air (kt CO2 eq)

Total 8.9 kt CO2 eq
Mean impact per tire 9.7 kg CO2e/PLT

Total processor burdens by month (Global Warming Potential)
Assumed average PLT weight of 10.5 kg




## 3.2 Collection and Freight

Estimated freight requirements for scrap tire collections by year are shown in Table 2. The average shipping distance for each tire is also reported, and is calculated by dividing total freight requirements by total collections.

For 2019, no freight data was available. For 2020–2021, origin municipalities were not directly linked to processor deliveries, so an average transport distance was calculated for each hauler and applied to all trips by that hauler. For 2022, origin municipality was specified for each delivery, so freight requirements are more accurate. Vehicle size was estimated from delivery size for each reported processor delivery.

Transactions indicating a transfer from one hauler to another could not be used to estimate freight requirements, and were not counted in the total quantity of tires collected or delivered to processors. This may lead to under-counting of freight requirements.

Table 2: Logistics requirements for scrap tire collection in Ontario (million tonne*km).

| | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|
| Transport truck_20t | – | 16.337 | 19.106 | 17.348 | 13.664 |
| Transport truck_5t | – | 4.822 | 5.172 | 3.019 | 4.163 |
| Transport truck_8t | – | 5.596 | 4.113 | 2.234 | 3.338 |
| Transport truck_13t | – | 4.481 | 3.883 | 3.085 | 2.179 |
| Transport light_truck_1.5t | – | 0.089 | 0.056 | 0.035 | 0.087 |
| Total | 0.000 | 31.325 | 32.331 | 25.720 | 23.431 |
| Average Distance (km) | – | 238. | 254. | 196. | 230. |

## 3.3 Processing Outputs

Tire-derived products in Ontario reported from all processing sites are shown in Table 3, and compared to total collections. Any tire-derived wastes reported are shown as well. Differences between tires collected and products generated are assumed to reflect changes in stock-on-hand at the processors. Over the last 3 years, the quantity of products reported by processors has reduced steadily. This may reflect a reduction in eTracks' overall market share as the province's dominant Producer Responsibility Organization.

Crumb remains the main product, occupying a steady share of about 65% of total production. Steel recovery tracks at roughly a fifth of crumb production. Due to changes in reporting, tire fiber destined for landfill is now reported as waste.

The production of several alternative products has diminished. TDF has dwindled from 10% to just over 5% of total products, while cut and fabricated products (blast mats) have reduced by a factor of three since 2020. Reuse and retread also show downward trends.

The consistency between reported products and reported collections (less than half a percent difference in 2023) suggests that there are no significant omissions from the collection data.

Table 3: Tire-derived products in Ontario (tonnes).

| | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|
| Crumb (product) | 78,958 | 88,436 | 81,670 | 71,685 | 65,602 |
| Retread / Remolding | 17,215 | 5,158 | 5,032 | 3,648 | 3,251 |
| Steel for recycling | 15,350 | 18,125 | 17,125 | 15,608 | 14,487 |
| Tire Fiber, Recovered | 8,747 | 10,660 | 10,699 | 9,885 | 0 |
| TDF fibre (product) | 6,672 | 8,671 | 6,552 | 6,580 | 5,562 |
| Cut / Fabricated (product) | 6,111 | 4,489 | 3,499 | 2,520 | 1,465 |
| Tire-derived waste | 3,428 | 4,851 | 4,141 | 3,466 | 10,793 |
| Reuse / Culls | 2,536 | 2,409 | 2,595 | 693 | 452 |
| Mulch (product) | 126 | 14 | 771 | 611 | 581 |
| Aggregate (product) | 42 | 0 | 0 | 0 | 9 |
| Total Products | 139,184 | 142,814 | 132,083 | 114,696 | 102,200 |
| Net Facility Stock Change | 6,365 | -10,959 | -4,716 | 16,435 | -455 |
| Total Collections | 145,549 | 131,854 | 127,367 | 131,132 | 101,745 |

## 3.4 Displaced Products

The products potentially displaced by tire-derived products are shown in Table 4. The amounts of potentially displaced products were calculated according to the displacement methodology described in the study report (Section 3.5) and in the provincial report (Appendix B).

The environmental effects of tire-derived products depend on their end-use fate. We estimated that the market for crumb in Ontario was roughly evenly split between athletic field infill, molded rubber products, and all other products. Most of the rest was allocated to rubberized asphalt production, with the remainder being concrete products, surfaces, and other primary rubber. This market split was applied for all years of the study. Recovered fibres were not assumed to displace any primary production.

Table 4: Primary products displaced by tire-derived products in Ontario, as modeled.

| | | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|
| Heat, coal, in cement kiln, displaced | GJ | 239,899 | 181,255 | 182,041 | 153,876 |
| Primary rubber, in product, displaced | t | 24,108 | 22,264 | 19,542 | 17,883 |
| Concrete product, displaced | t | 17,606 | 16,259 | 14,271 | 13,060 |
| Acrylic coated sand, displaced | t | 15,476 | 14,292 | 12,545 | 11,480 |
| Steel, displaced | t | 13,594 | 12,844 | 11,706 | 10,865 |
| New tire, displaced | t | 4,007 | 3,970 | 2,581 | 2,258 |
| Sand, displaced | t | 3,528 | 4,709 | 4,006 | 3,708 |
| Primary rubber, polybutadiene | t | 1,990 | 1,838 | 1,613 | 1,476 |
| Wood Chips, displaced | t | 1,655 | 2,211 | 1,881 | 1,741 |
| Silage weight, displaced | t | 1,515 | 1,181 | 851 | 494 |
| Roadway mix and service lifetime | km | 1,240 | 1,145 | 1,005 | 920 |
| Blast Mat, steel cord, displaced | m2 | 9,481 | 7,390 | 5,323 | 3,094 |
| Aggregate, gravel, displaced | kg | 0 | 0 | 0 | 11,053 |

# 4 Results and Interpretation

This section reports quantitative results of the life cycle impact assessment for the recent years. Results have two types of contributions: positive-valued (incurred) contributions and negative-valued (displaced) contributions.

- Positive-valued contributions result from direct actions taken within the scrap tire management system that have environmental impacts. These include emissions from transportation of tires from collection centers to processors, direct emissions from facility operations, upstream emissions from materials used by processors, and emissions from electricity generation.
- Negative-valued contributions represent emissions associated with the production of products that compete with tire-derived products in the marketplace, and so are potentially avoided by the use of scrap tires.

The sum of these positive and negative impacts indicates the potential net environmental impacts that could occur if tire-derived products are displacing primary products.

## 4.1 Uncertainty

The LCA model includes uncertainty in the recycling process inventories, and in the market effects of tire-derived products. The charts in this section indicate uncertainty in the results by including error bars or "whiskers" that extend upward and downward from an indicated result or a net total. The size of the error bar indicates the uncertainty in the estimate.

Uncertainty is applied to the following parameters (please consult the study report, Section 4.2, for details):

- In the displacement relationship between tire-derived products and the products with which they compete, we apply uncertainty to the amount of displacement according to the type of product being displaced;
- Inventory parameters that describe scrap tire processing, such as electricity and diesel
- Freight requirements for scrap tire collection;
- Aspects of tire composition, including biogenic carbon and zinc content.

Each unit of tire-derived product is considered to replace anywhere between 0.2–1 equivalent unit of displaced product, depending on the nature of the product. This is called the displacement rate. Error bars on the negative-valued contributions reflect this uncertainty only, while error bars on net results reflect all uncertainties. Displacement relationships are reported in Appendix B of the provincial report.

# 2023

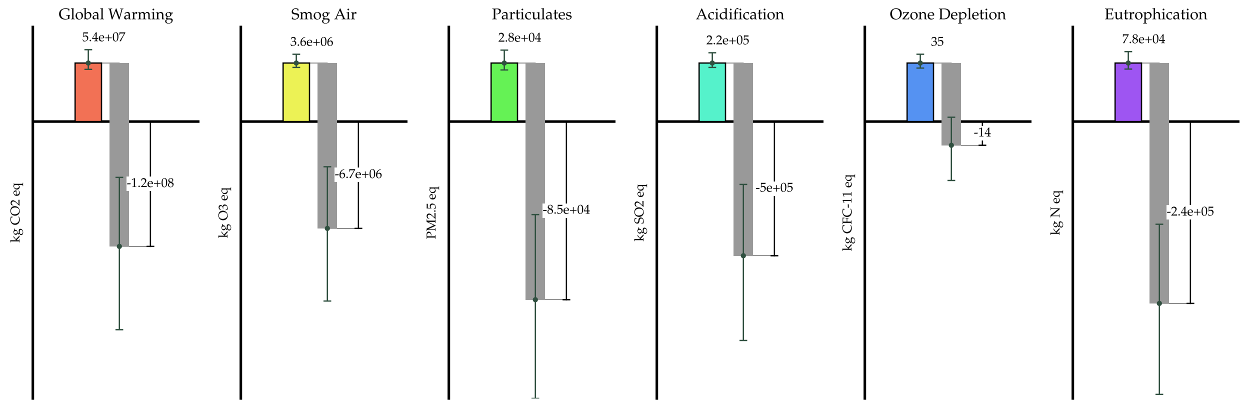



Figure 2: Total impacts incurred and avoided due to scrap tire management during 2021 (top) and 2022 (bottom). The colored bar in each panel indicates incurred emissions in the named category, while the gray bar indicates potentially avoided emissions in that category.

Table 5: Total impacts incurred, total impacts avoided, and net total impacts due to tire recycling in Ontario during 2023.

| | Unit | Incurred Impacts | Avoided Impacts | Net Total |
|---|---|---|---|---|
| Global Warming Air | kg CO2 eq | 5.4e+07 | -1.7e+08 | -1.2e+08 |
| Smog Air | kg O3 eq | 3.6e+06 | -1e+07 | -6.7e+06 |
| Human Health Particulates Air | PM2.5 eq | 2.8e+04 | -1.1e+05 | -8.5e+04 |
| Acidification Air | kg SO2 eq | 2.2e+05 | -7.1e+05 | -5e+05 |
| Ozone Depletion | kg CFC-11 eq | 35 | -50 | -14 |
| Eutrophication Air + Water | kg N eq | 7.8e+04 | -3.2e+05 | -2.4e+05 |
| Blue water depletion | m3 | 1.4e+06 | -6.9e+06 | -5.5e+06 |

The results are shown graphically in Figure 2. The same data can be found in tabular form in Table 5. Blue water was omitted from Figure 2 because it was highly imbalanced between incurred and avoided impacts. The most-negative point on each bar indicates the most favorable displacement assumption (i.e. a tonne of tires displaces nearly a tonne of primary product).

In five out of six headline indicators, plus water depletion (see next section), the operation of the scrap tire management program in Ontario has resulted in the reduction of environmental impacts through displaced production. These results are robust to uncertainty in model parameters and displacement rates. In the final category, ozone depletion, incurred and avoided impacts were roughly balanced but resulting in a net increase in emissions.

## 4.2 Water Depletion

In the 2024 update, we added water depletion to the set of indicators we measured for the study. Water depletion is measured in terms of net water withdrawals from natural reservoirs, also known as “Blue Water”, and comprises the sum of total water withdrawals, minus total returns to water. Water depletion is measured in cubic meters.

Our results showed that steel recycling is by far the greatest driver of avoided net water withdrawals, outpacing all other sources of incurred or avoided impact. The steel recycling inventory information is taken from the World Steel Association “Value of Scrap” dataset. This is a synthetic dataset made to estimate the changes to global steel production as a result of increased scrap supply. We have moderate confidence in the quality of this dataset

Note that water depletion is a global indicator, and water withdrawals will not necessarily occur near the location of the process being modeled. More information on the water depletion indicator will be available in the 2024 update report later this year.

The results for Ontario in 2023 are shown on the Waterfall chart in Figure 3. On the waterfall chart, incurrec impacts (i.e. withdrawals of water) are represented as bars growing toward the right, and avoided impacts (i.e. avoided water withdrawals) are shown as bars growing toward the left. The net result, which is the accumulation of all bars, is shown by the red triangle at the bottom.

The consistent generation of scrap steel from tire recycling in Ontario leads to a significant reduction in net water withdrawals for the province. If steel recycling is excluded, the benefits from other avoided production, particularly molded products, approximately balance the incurred impacts.

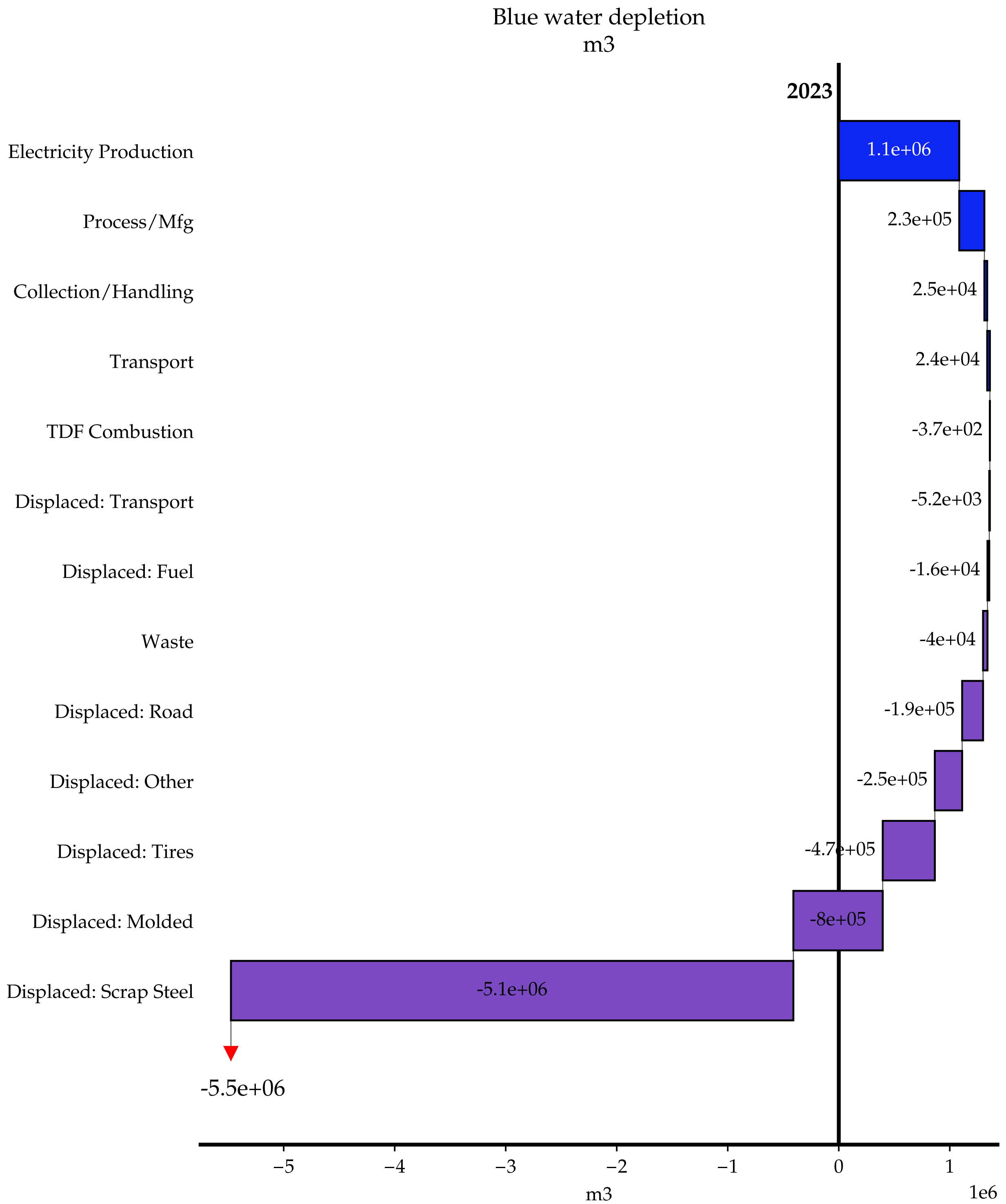



Figure 3: Waterfall chart indicating the contributors to the newly-added water depletion score. The chart shows that the electric grid is the largest source of net water withdrawals, and that steel recycling is by far the greatest contributor to avoided water consumption.

## 4.3 Stage Contribution Analysis

The impact category scores are disaggregated into different stages in Figure 4. Thes chart enables a visual comparison of the relative contributions of different parts of the scrap tire management system in each impact category. Figure 5 shows the same information on a year-over-year basis for 2019–2023, providing a depiction of how the results changed over time.

The results show that all the various tire-derived products produced in Ontario contribute to avoided burdens in the province, with molded rubber products and reduced roadway construction and maintenance being the largest contributors. Meanwhile processing impacts are the largest contributors to incurred burdens.

The indicators show a gradual reduction in magnitude over the course of the study, following the reduced collections reported. The 2019 year is somewhat anomalous because it is based on RPRA reporting, but it shows the largest savings due to displaced tire production because of higher volumes of retreading (17 kt).

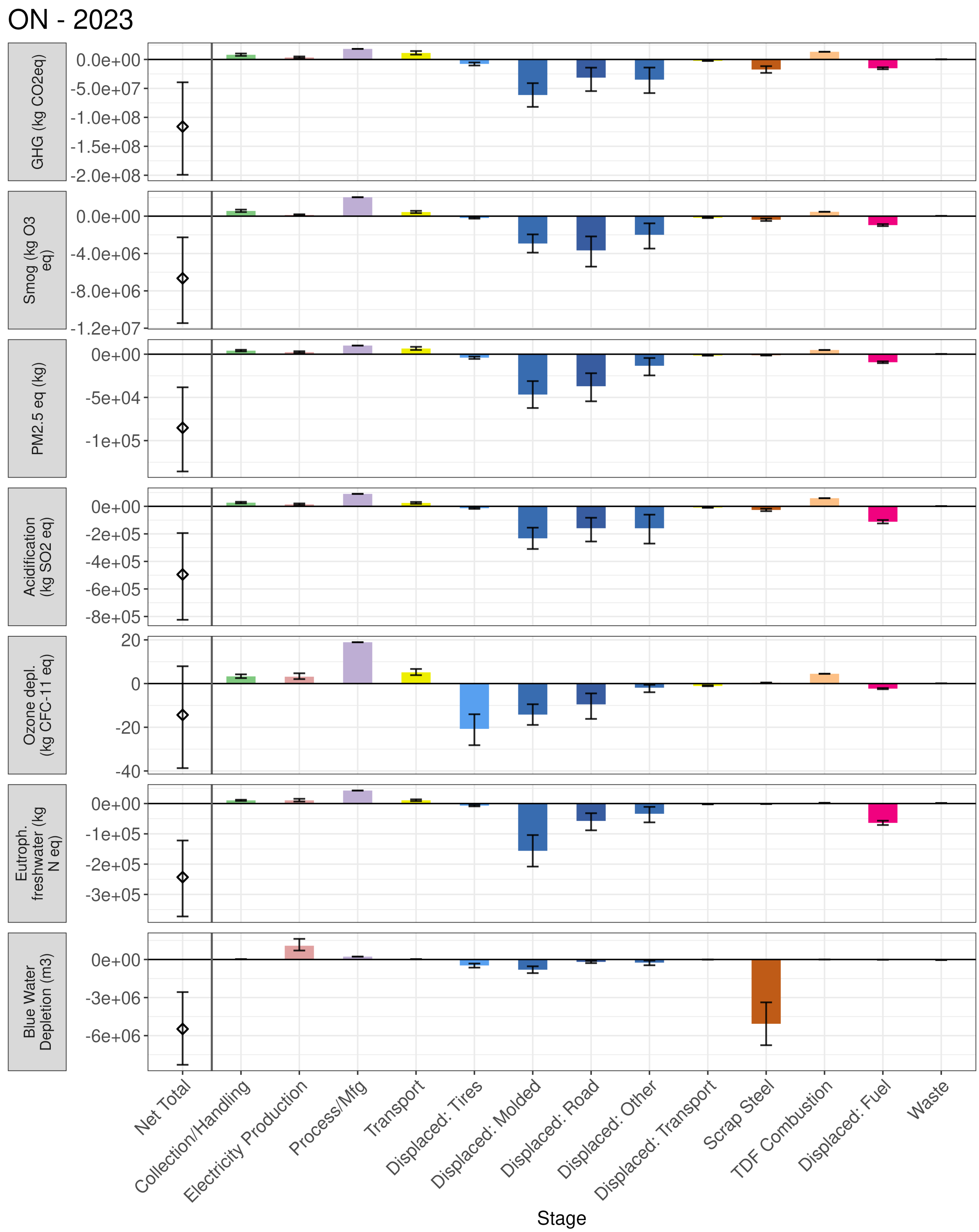



Figure 4: Province-wide environmental impacts of managing scrap tires in ON during 2023, stage contribution analysis. Net impacts, which take into account avoided production due to tire recycling, are indicated by the diamond symbol on the left. Colored bars show contributions by individual stages in the tire recycling system. Modeled uncertainty is indicated for each bar.

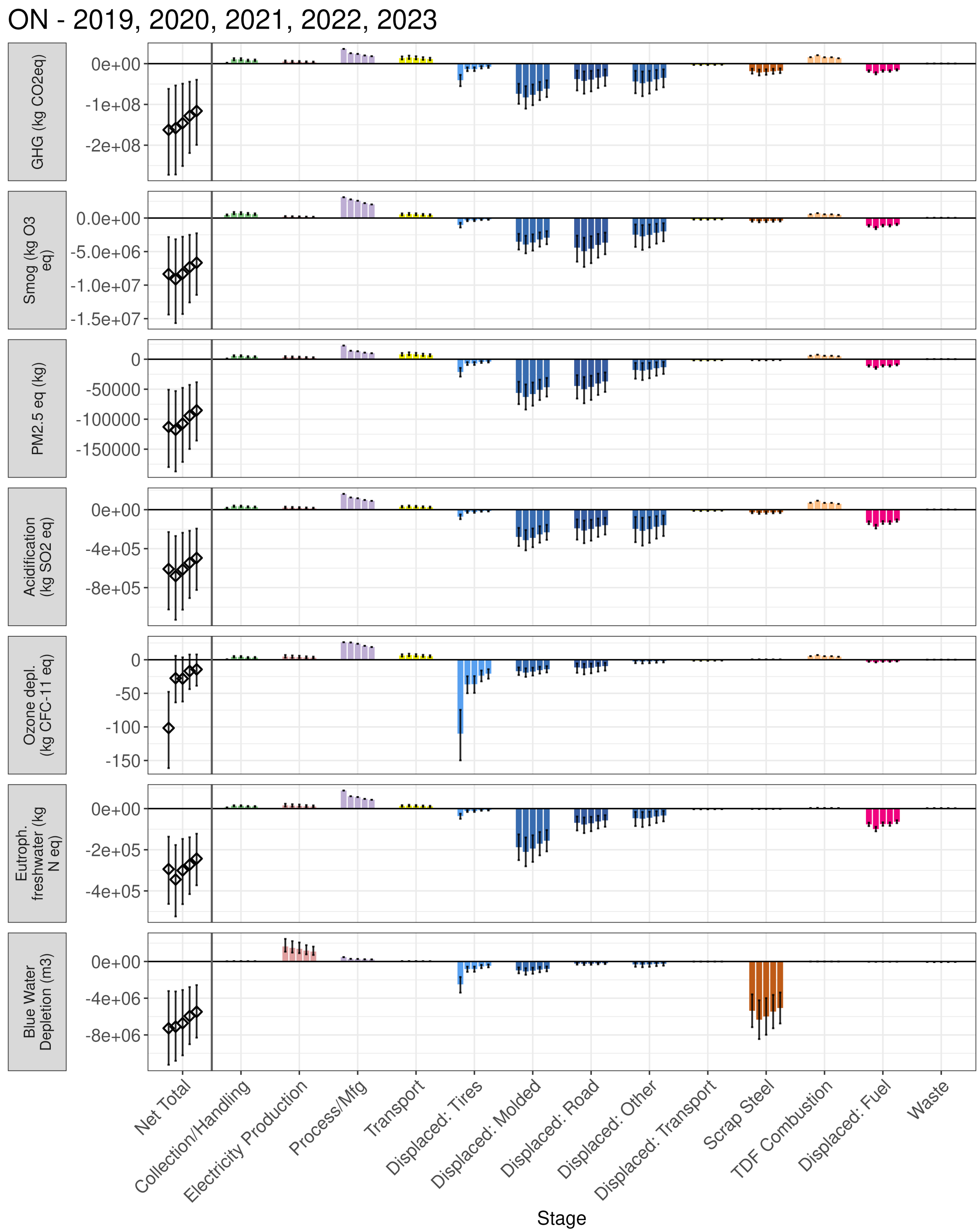



Figure 5: Province-wide environmental impacts of managing scrap tires in ON during 2019–2023, stage contribution analysis, by year. Net impacts, which take into account avoided production due to tire recycling, are indicated by the diamond symbol on the left. Colored bars show contributions by individual stages in the tire recycling system. Modeled uncertainty is indicated for each bar.