

Wide-Base and Low Rolling Resistance Tires Calculator User Guide

The Wide-Base and Low Rolling Resistance Tires Calculator is a tool that enables you to determine potential fuel and monetary savings. You can also use it to determine the reduction of greenhouse gas (GHG) emissions resulting from the installation of wide-base and low rolling resistance tires and to estimate the payback for such an investment.

This guide explains the information to be entered in the calculator. It also explains the assumptions and calculations embedded in the calculator, some of which can be changed to better reflect a specific situation.

The Wide-Base and Low Rolling Resistance Tires Calculator is organized as follows:

Wide-Base Tires Section

Inputs

1. Added cost per axle for tractor drive axles: tires and rims purchase and installation cost:
 - This scenario is for when wide-base tires are purchased as a replacement to dual tires for an existing vehicle. For new vehicle purchases, per unit cost for wide-base tires including rims is less than dual tires.
 - If purchased as a replacement to dual tires for an existing vehicle, the purchase of wide-base tires will be less than dual tires by approximately \$100. The cost of new rims to accommodate the wide tires will be about \$400 per wheel end. Therefore, in a replacement scenario, wide tires will add \$300 in cost per wheel end, which means \$600 per axle.

TIP: Input the added tires and rims purchase and installation cost per axle for tractor drive axles (Md): default value is \$600.
2. Number of tractor drive axles equipped with wide-base tires:
 - The default scenario assumes a tandem drive tractor (which is a tractor equipped with two drive-axles).



TIP: Input the number of tractor drive axles equipped with wide-base tires (d): default value is 2 axles.

3. Added cost per axle for trailer axles: tires and rims purchase and installation cost:

- This scenario is for when wide-base tires are purchased as a replacement to dual tires for an existing vehicle. For new vehicle purchases, per unit cost for wide-base tires including rims is less than dual tires.
- If purchased as a replacement to dual tires for an existing vehicle, the purchase of wide-base tires will be less than dual tires by approximately \$100. The cost of new rims to accommodate the wide tires will be about \$400 per wheel end. Therefore, in a replacement scenario, wide tires will add \$300 in cost per wheel end, which means \$600 per axle.

TIP: Input the added tires and rims purchase and installation cost per axle for trailer axles (Mt): default value is \$600.

4. Number of trailer axles equipped with wide-base tires:

- The default scenario assumes a tandem semi-trailer (which is a two-axle semi-trailer).

TIP: Input the number of trailer axles equipped with wide-base tires (d): default value is 2axles.

5. Total added cost:

- Is calculated as a function of added cost per axle for tractor drive axles (Md), number of tractor drive axles equipped with wide-base tires (d), added cost per axle for trailer axles (Mt), and number of trailer axles equipped with wide-base tires (t),
- Using the equation: $P = Md \times d + Mt \times t$.
- Therefore, in the default replacement scenario, wide tires will add \$2,400 per tractor- trailer combination (tandem drive axle tractor with two-axle semi-trailer).

6. Fuel savings:

- Tests performed by tire manufacturers have shown that in a typical five-axle vehicle combination, trailer tires account for 41% of total rolling resistance and that for double-trailer combinations, the rolling resistance of the trailer tires increases to 62% of the total.
- High-speed track tests at Energotest™ showed fuel savings of up to 9.7% for a tractor-semi-trailer combination (tandem drive axle tractor with a two-axle semi-trailer) equipped with wide-base tires and up to 5% for tractor drive axles only. Therefore, the calculator assumes that on average the efficiency improvement resulting from the use of wide-base tires is the same for tractors and trailers axles.



TIP: Input the certified percentage fuel savings for your wide-base tires (F) (as recognized by an independent organization, such as the U.S. Environmental Protection Agency's SmartWaySM program, or FPIInnovation's EnergotestTM): default value is 9.7%.

7. Annual mileage:

- Tire life for wide-base tires is comparable to regular tires.
- You have the choice of kilometres or miles.

TIP: Input your tractor's actual average yearly mileage (K): default value is 200 000 km.

8. Proportion of annual mileage driven at speeds of 80 km/h or more (%):

- The test result mentioned above was obtained at constant high speed: as a conservative approach. We assume that the test results would apply only under similar conditions, and would thus apply primarily to trips on roads with a posted maximum speed of 80 km/h or more.

TIP: Input your actual percentage (p): default value is 80%.

9. Annual applicable mileage:

- Is calculated as a function of the percentage of annual mileage driven at speeds of 80 km/h or more (p), and of the average annual mileage of the tractor (K),
- Using the equation: $S = K \times p$.

10. Fuel price:

- Fuel price fluctuates and has a direct and significant impact on annual savings and payback periods.

TIP: Input the actual fuel price in ¢/L (X): default is 110 ¢ /L.

11. Current fuel consumption:

- This is your fuel consumption prior to installing the wide-base tires.
- You have the choice of L/100 km or mpg (US).

TIP: Input your actual fuel consumption (Y): default value is 34 L/100 km.

Results

➤ Annual fuel savings:

- Is calculated as a function of: annual applicable mileage (S), percentage fuel savings (F), and actual fuel consumption (Y),



- Using the equations:
 - For fuel consumption in L/100 km: $A = f \times S \times F \times Y$
 - For fuel consumption in mpg: $A = f \times S \times F / Y$
- Where f is a conversion factor, calculated based on the user's input for units of distance and fuel consumption. The below table is provided for information only:

Unit of S	Unit of Y	f	Conversion factor (f) formula
km	L/100 km	1	km x L/100km
km	mpg	235.25	km x L/100km (=3.786 x 100/(1.61 x mpg))
miles	L/100 km	1.61	km (=1.61 x miles) x L/100km
miles	mpg	378.60	km (=1.61 x miles) x L/100km (=3.786 x 100/(1.61 x mpg))

- Example for converting a mileage of 100 000 miles in kilometres and a fuel economy of 6 mpg in fuel consumption to L/100 km:
 - Mileage: 100 000 miles = 100 000 x 1.61 km = 161 000 km,
 - 6 mpg = 3.786 x 100/(1.61 x 6) = 39.2 L/100 km,
 - Total conversion factor: 1.61 x 3.786 x 100/1.61 = 378.60.

TIP: To obtain the total annual fuel savings resulting from the installation of wide-base tires in your fleet, multiply the annual fuel savings per vehicle combination by the number of vehicle combinations equipped with wide-base tires.

➤ Annual greenhouse (GHG) emissions reduction:

- The most prevalent GHGs released by the burning of diesel fuel are carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O). The production of the other two GHGs is extremely low compared with CO₂, so they are usually not considered for estimation purposes.
- The potential of reducing GHG emissions is calculated based on the annual fuel savings (A) considering that the combustion of diesel fuel produces 2.7 kg CO₂ equivalent per litre, with the equation: $G = A \times 2.7$.



TIP: To obtain the total annual GHG emission reduction resulting from the installation of wide-base tires in your fleet, multiply the annual GHG emission reduction per vehicle combination by the number of vehicle combinations equipped with wide-base tires.

➤ Annual savings:

- Annual savings are calculated as a function of: annual fuel savings (A), and fuel price (X),
- With the equation: $B = A \times X$,

TIP: To obtain the total annual savings resulting from the installation of wide-base tires in your fleet, multiply the annual savings per vehicle combination by the number of vehicle combinations equipped with wide-base tires.

➤ Payback period:

- Is calculated as a function of: purchase and installation cost (P), and of annual savings (B);
- Using the equation: $C = P / B$.

Assumptions

- This scenario is for when wide-base tires are purchased as a replacement to dual tires for an existing vehicle. For new vehicle purchases, per unit cost for wide-base tires including rims is less than dual tires.
- Tire life for wide-base tires is comparable to regular tires.
- High-speed track tests at Energotest™ showed fuel savings of up to 9.7% for a tractor-trailer (tandem drive axle tractor with two-axle semi-trailer) equipped with wide-base tires up to 5% for tractor drive axles only.

Disclaimer

- The purpose of these simplified models is to demonstrate the cost-saving opportunities available for fleet owners through best practices and fuel-saving devices.
- The model can be refined further based on the customer's requirements.
- The user is responsible for verifying the accuracy of the results.
- In no event shall Transport Canada be liable to any direct, consequential, incidental, special, punitive or other damages.
- In Canada, legal axle weights are reduced in some provinces for vehicles with wide-base tires, which must be considered when choosing this type of tire.



Low Rolling Resistance Tires Section

Inputs

1. Added cost per axle for tractor steer axles: tires and rims purchase and installation cost:
 - The cost of low rolling resistance tires is comparable to regular tires, and they can be installed on the same rims used for normal tires.

TIP: Input the added tires and rims purchase and installation cost per axle for tractor steer axles (Ms): default value is \$0.
2. Number of tractor steer axles equipped with low rolling resistance tires:
 - The default scenario assumes that steer axles are not equipped with low rolling resistance tires, which was the situation for the high-speed track test presented below.

TIP: Input the number of tractor steer axles equipped with low rolling resistance tires (s): default value is 0 axles.
3. Added cost per axle for tractor drive axles: tires and rims purchase and installation cost:
 - The cost of low rolling resistance tires is comparable to regular tires, and they can be installed on the same rims used for normal tires.

TIP: Input the added tires and rims purchase and installation cost per axle for tractor drive axles (Md): default value is \$0.
4. Number of tractor drive axles equipped with low rolling resistance tires:
 - The default scenario assumes a tandem drive tractor (which is a tractor equipped with two drive-axles).

TIP: Input the number of tractor drive axles equipped with low rolling resistance tires (s): default value is 2 axles.
5. Added cost per axle for trailer axles: tires and rims purchase and installation cost:
 - The cost of low rolling resistance tires is comparable to regular tires, and they can be installed on the same rims used for normal tires.

TIP: Input the added tires and rims purchase and installation cost per axle for trailer axles (Mt): default value is \$0.
6. Number of trailer axles equipped with low rolling resistance tires:



- The default scenario assumes that trailer axles are not equipped with low rolling resistance tires, which was the situation for the high-speed track test presented below.

TIP: Input the number of trailer axles equipped with low rolling resistance tires (t): default value is 0 axles.

7. Total added cost:

- Is calculated as a function of: added cost per axle for tractor steer axles (Ms), number of tractor steer axles equipped with low rolling resistance tires (s), tractor drive axles (Md), number of tractor drive axles equipped with low rolling resistance tires (d), added cost per axle for trailer axles (Mt), and number of trailer axles equipped with low rolling resistance tires (t),
- Using the equation: $P = Ms \times s + Md \times d + Mt \times t$.

8. Fuel savings:

- All major tire manufacturers now offer fuel-efficient tires with approximately 20% less rolling resistance than conventional tires, and they claim fuel savings from 4 to 12% compared to normal tires.
- Tests performed by tire manufacturers have shown that in a typical five-axle vehicle combination, trailer tires account for 41% of total rolling resistance and that for double-trailer combinations, the rolling resistance of the trailer tires increases to 62% of the total. Therefore, the calculator assumes that on average the efficiency improvement resulting from the use of low rolling resistance tires is the same for tractors and trailers axles.
- High-speed track tests at Energotest™ showed fuel savings of up to 2.4% for a tractor-trailer (tandem drive axle tractor with two-axle semi-trailer) equipped with low rolling resistance tires on tractor drive axles only.

TIP: Input the certified percentage fuel savings for your low rolling resistance tires (F) (as recognized by an independent organization, such as the U.S. Environmental Protection Agency's SmartWaySM program, or FPInnovation's Energotest™): default value is 2.4%.

9. Annual mileage:

- Tire life for low rolling resistance tires is comparable to regular tires.
- Since most of the fuel savings are the result of a more efficient tread design, the improvement in fuel economy decreases to the point where it is the same as regular tires as the tires wear and the treads become depleted. Therefore, these savings are only realized for half the tire life.



- You have the choice of kilometres or miles.

TIP: Input your actual average yearly mileage (K): default value is 200 000 km.

10. Proportion of annual mileage driven at speeds of 80 km/h or more (%):

- The tests were conducted at constant high speed: as a conservative approach, we assume that the test results would apply only under similar conditions, and would thus apply primarily to trips on roads with a posted maximum speed of 80 km/h or more.

TIP: Input your actual percentage (p): default value is 80%.

11. Annual applicable mileage:

- Is calculated as a function of: percentage of annual mileage driven at speeds of 80 km/h or more (p), and the average annual mileage of the tractor (K),
- Using the equation: $S = K \times p$.

12. Fuel price:

- Fuel price fluctuates and has a direct and significant impact on annual savings and payback period.

TIP: Input the actual fuel price in ¢/L (X): default is 110 ¢/L.

13. Current fuel consumption:

- This is your fuel consumption prior to installing the low rolling resistance tires.
- You have the choice of L/100 km or mpg (US).

TIP: Input your actual fuel consumption (Y): default value is 34 L/100 km.

Results

➤ Annual fuel savings:

- We assume that the initial savings are only realized for the half the tire life.
- Annual fuel savings are calculated as a function of: annual applicable mileage (S), percentage fuel savings (F), and actual fuel consumption (Y),
- Using the equations:
 - For fuel consumption in L/100 km: $A = f \times (S / 2) \times F \times Y$
 - For fuel consumption in mpg: $A = f \times (S / 2) \times F / Y$



- Where f is a conversion factor, calculated based on user's input for units of distance and fuel consumption. The below table is provided for information only:

Unit of S	Unit of Y	f	Conversion factor (f) formula
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TIP: To obtain the total annual fuel savings resulting from the installation of low rolling resistance tires in your fleet, multiply the annual fuel savings per vehicle combination by the number of vehicle combinations equipped with low rolling resistance tires.

➤ Annual greenhouse (GHG) emission reduction:

- The most prevalent GHGs released by the burning of diesel fuel are carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O). The production of the other two GHGs is extremely low compared with CO₂, so they are usually not considered for estimation purposes.
- The potential of reducing GHG emissions is calculated based on the annual fuel savings (A) considering that the combustion of diesel fuel produces 2.7 kg CO₂ equivalent per litre, with the equation: $G = A \times 2.7$.

TIP: To obtain the total annual GHG emission reduction resulting from the installation of low rolling resistance tires in your fleet, multiply the annual GHG emission reduction per vehicle combination by the number of vehicle combinations equipped with low rolling resistance tires.

➤ Annual savings:

- Is calculated as a function of: annual fuel savings (A), and fuel price (X),
- With the equation: $B = A \times X$.



TIP: To obtain the total annual savings resulting from the installation of low rolling resistance tires in your fleet, multiply the annual savings per vehicle combination by the number of vehicle combinations equipped with low rolling resistance tires.

- Payback period:
 - Is calculated as a function of: purchase and installation cost (P), and of annual savings (B);
 - Using the equation: $C = P / B$.

TIP: The payback is immediate if the payback period value is zero.

Assumptions

- Tire life for low rolling resistance tires and regular tires is considered to be similar.
- The fuel savings are only realized for half the tire life.
- The low rolling resistance tires can be installed on the same rims as the regular tires.
- High-speed track tests at Energotest™ showed fuel savings of up to 2.4% for a tractor-trailer (tandem drive axle tractor with two-axle semi-trailer) equipped with low rolling resistance tires on tractor drive axles only.

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- The purpose of these simplified models is to demonstrate the cost-saving opportunities available for fleet owners through best practices and fuel-saving devices.
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