Tire Innovations to Improve Fuel Economy

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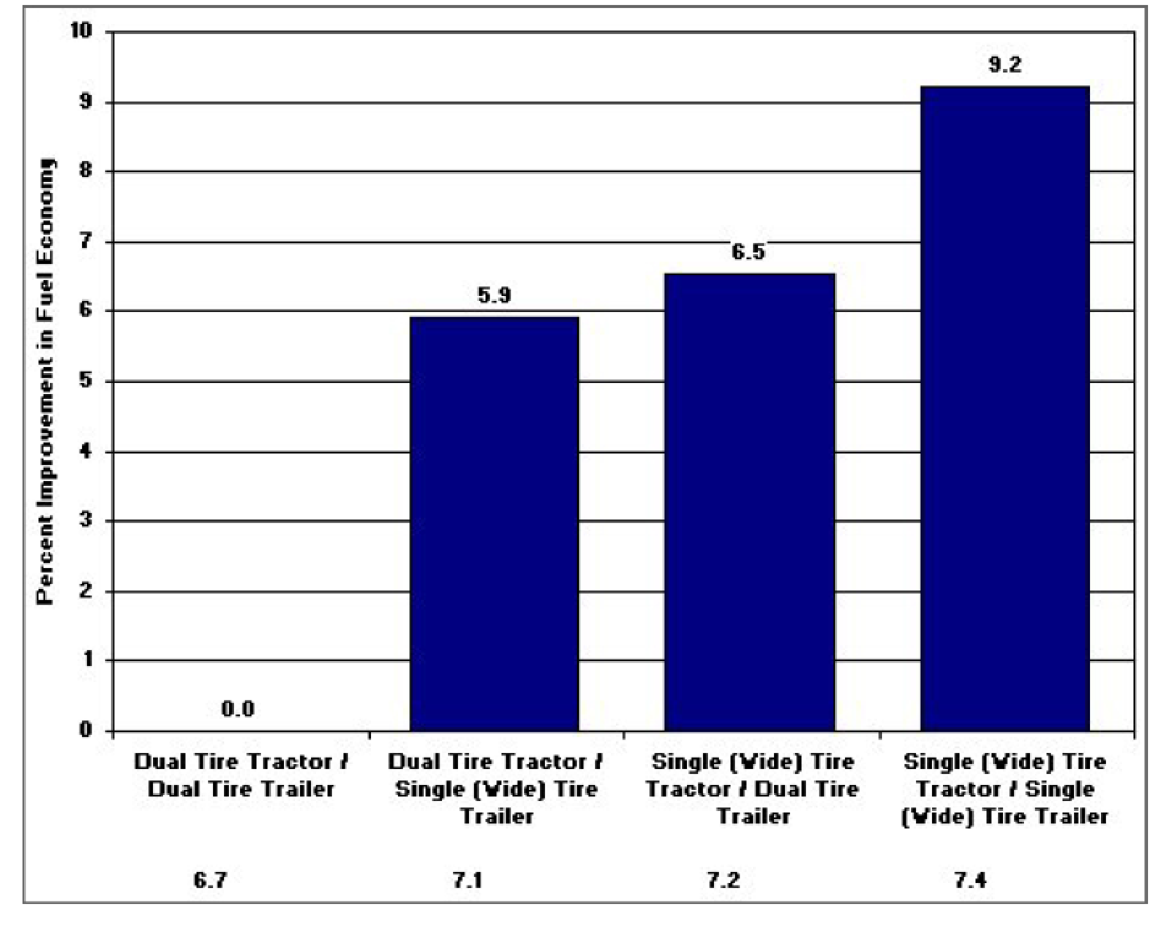


Wide Base Single tires improve fuel economy by 9.2%!

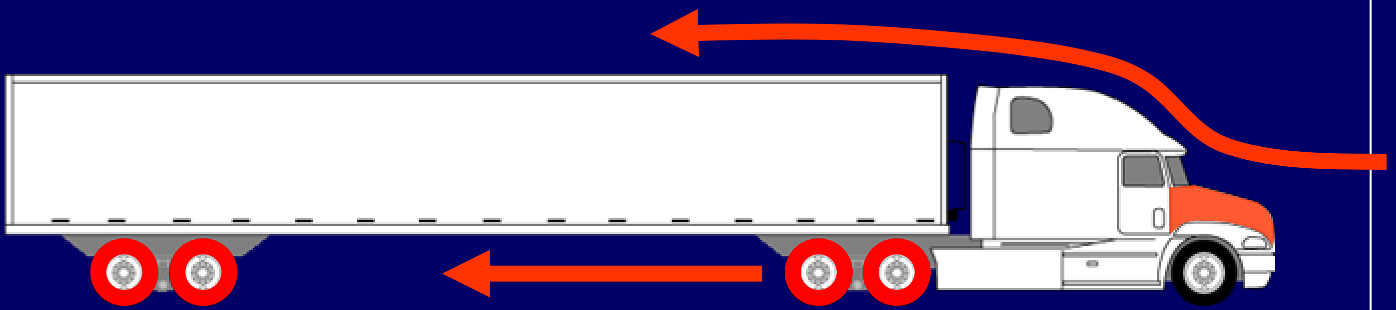
Tire Contribution to Fuel Consumption

aerodynamic drag

mechanical losses

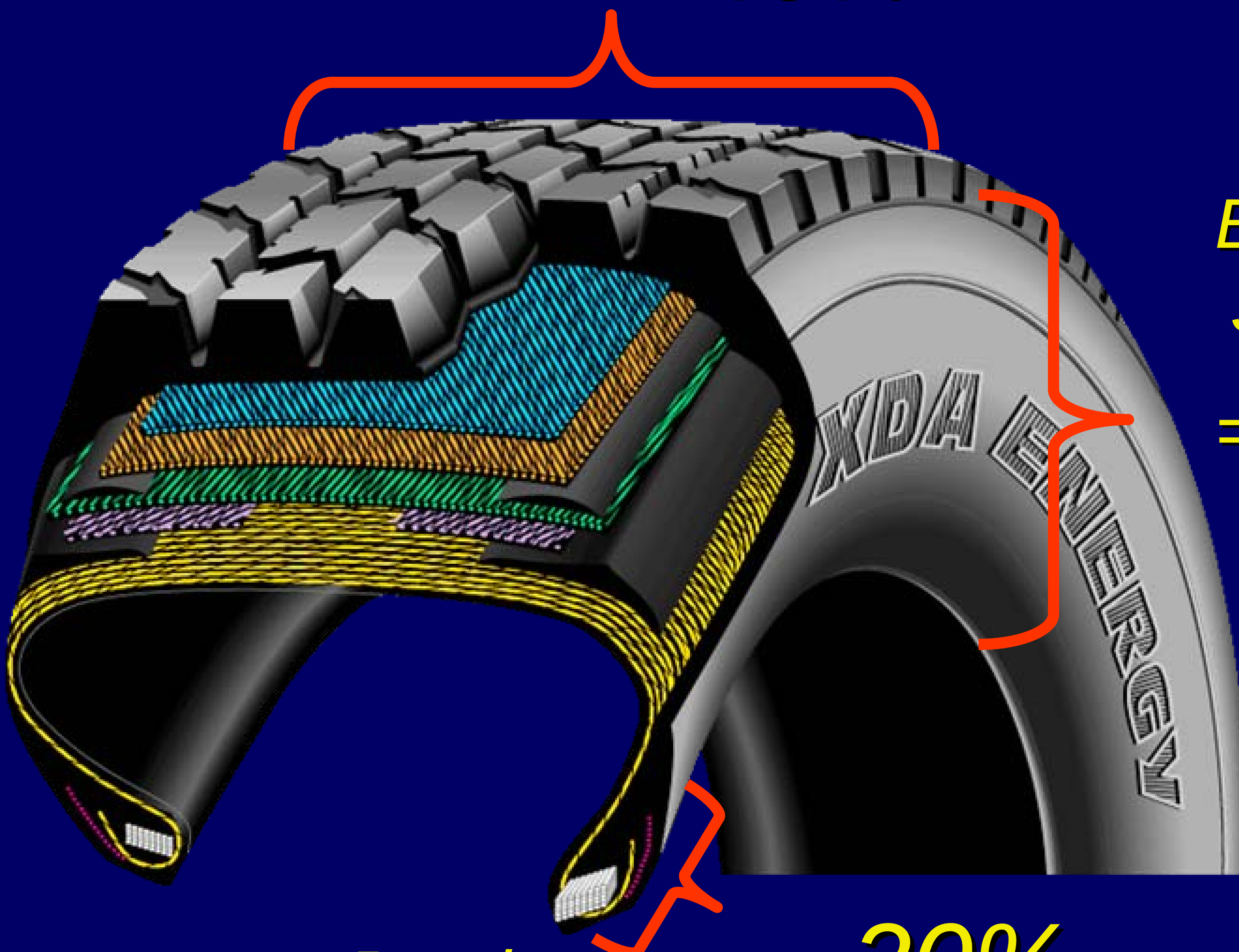
rolling resistance

A truck engine has to overcome three major forces in order to maintain speed:



Tires are 1/3 of vehicles fuel usage or approximately 2 mpg

How tires consume fuel



How Tires Consume Fuel

- Hysteresis is the amount of energy lost (in the form of heat) due to the movement/compression of rubber.
- A loaded tire has a flat contact patch.
- Pushing a round tire through a flat contact patch consumes energy = uses fuel.
- Tires are not perfectly elastic.
- This is Rolling Resistance

Tire Designer's Tools to Improve Rolling Resistance

- Rubber compounding
  - more elastic (less hysteretic) Energy Compounds
  - Co-extrusion Technologies
  - Optimizing compounding in casing sidewall and bead areas
- Make tires with less mass to move around (mass reduction) – ***X One***
- Control footprint shape / contact forces through tire architecture

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Effect of Rubber Compound

HIGH TECH
COMPOUNDING

5.8 lbs/1000lbs

7.8 lbs/1000lbs

Reduction of 25% RR vs. 1980's tires

Effect of Tread Design

LOW TREAD
DEPTH

4.5 lbs/1000lbs

8 lbs/1000lbs

Trailer Rib is 44% better in RR than Traction-Drive

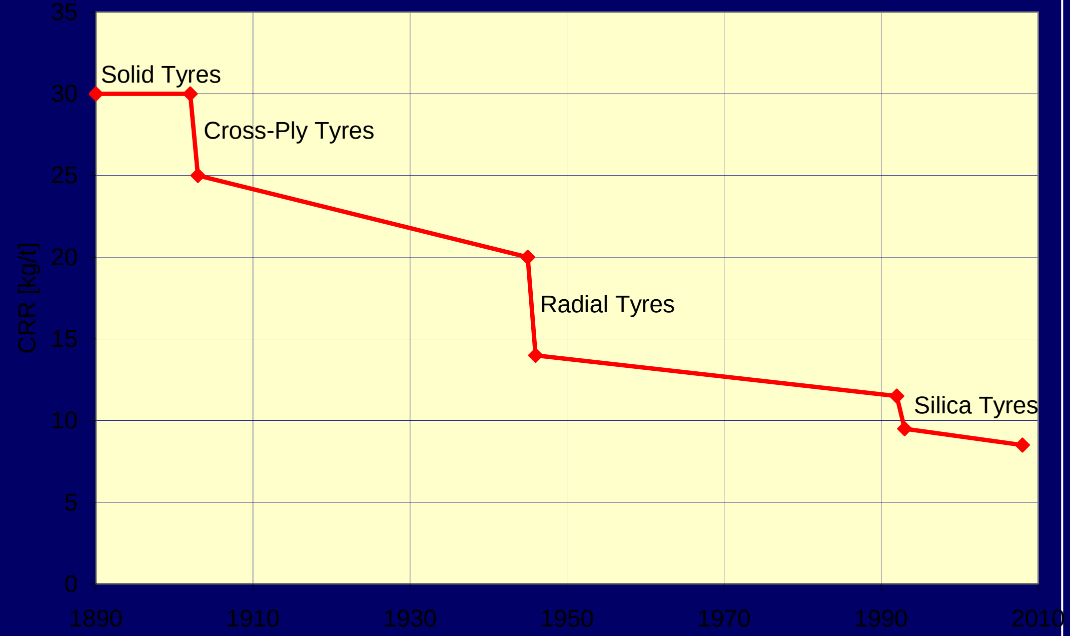
Effect of Tire Design

5.8 lbs/1000lbs

5 lbs/1000lbs

Weight can save 15% RR

Evolution of Tire RR



- Radial tires in 1946
- Introduction of silica in 1992

- Optimization of architecture
- Optimization of material compounds
- Optimization of tread sculpture

Tire Design Breakthroughs

- More efficient rubber compounds
  - 25+% Reduction in RR since 1980
- Lower tread depth
  - New tread designs and better wearing compounds allowing shallower tread depths
- Lower mass tires – ***X One Wide Base Singles***
  - ***170 lb to 200 lb reduction per axle***

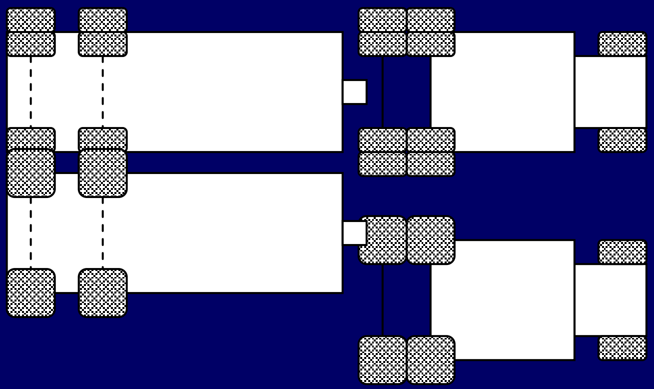
18-Wheelers to 10-Wheelers

- In 1908, Michelin invented both the product and the concept of “paired” or dual tires to increase load carrying capacity for heavy trucks.

- In 2000, Michelin introduced the X One wide base single.

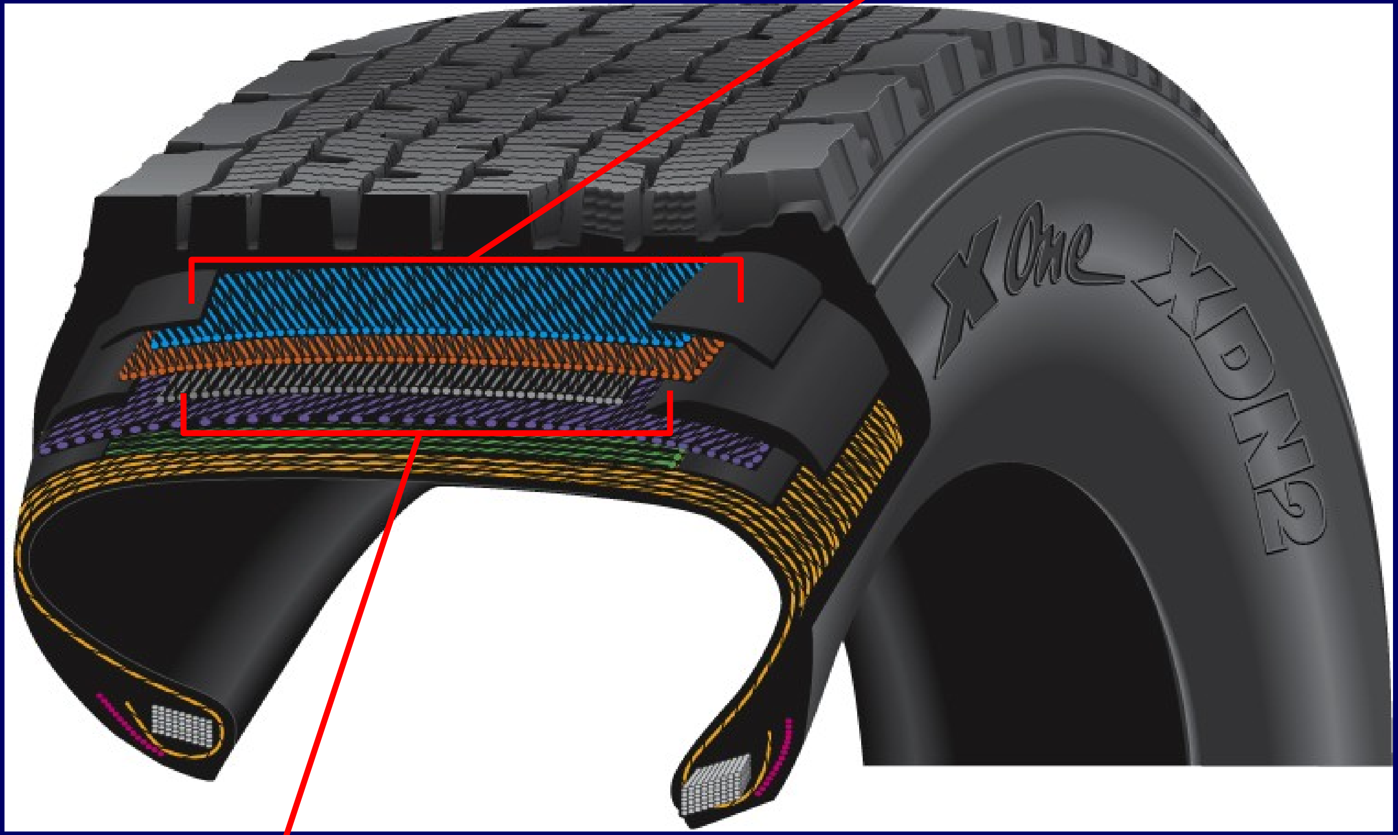
18 wheels:

10 wheels:



- Over 3/4 million X One tires sold to date
- Used by hundreds of fleets and thousands of drivers
- Measured fuel savings from 4% to 10% saving 8MT to 18MT GHG/yr.

Full Width Steel Protection
helps reduce penetrations



Unique Infini-Coil™ Technology
¼ mile of steel cable to help eliminate casing growth
and maintain a consistent footprint for even wear

X One XDA X One XDN2 X One XTA X One XTE X One XZUS X One XZY3 X One XRV

- Almost 1 million tires sold since introduction
- Over 55,000 retreads sold since introduction
- Over 450,000 14” wheel positions estimated
- Lineup expanded to large variety of applications

Conclusion

- Tire selection is an important part of fuel economy.
- Today's tires offer a wide variety of rolling resistance (i.e. more than 1.0 mpg - best to worse)
- New Wide Single tires (X Ones) have allowed for unprecedented fuel economy and are cost effective **TODAY!**

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Thank you

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