DOCKETED	
Docket Number:	20-TIRE-01
Project Title:	Tire Efficiency Order Instituting Information Proceeding
TN #:	248802
Document Title:	Presentation - Smithers Test Results, February 14, 2023
Description:	Presentation from Smithers discussing tire test results during the Replacement Tire Efficiency Pre-Rulemaking Staff Workshop February 14, 2023
Filer:	Sebastian Serrato
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	2/14/2023 4:47:23 PM
Docketed Date:	2/14/2023

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Tire Testing for California's Replacement Tire Efficiency Program

Assembly Bill 844 January 2023

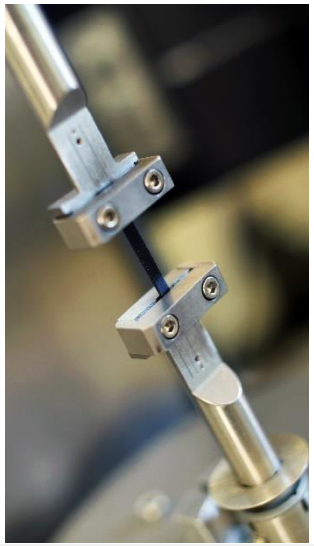
Replacement Tire Efficiency Pre-Rulemaking
Staff Workshop: February 14, 2023

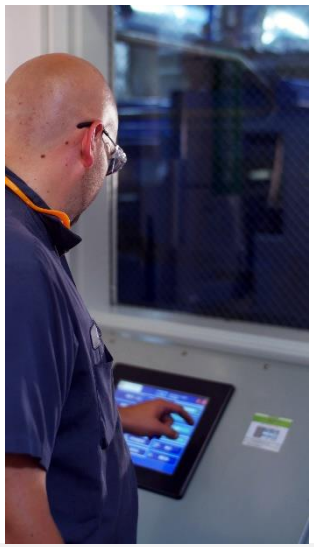
Smithers: Trusted Global Partner

Independent third-party **laboratory testing** and **consulting**
Incisive **strategic consulting**, **market forecasting** and **events**

- Successfully operating for **95 years**
- **900+** employees
- **World-class** facilities and expertise
- **Continual investment** in scientific and engineering talent
- Scientists and engineers who are **experts** in their field

Materials Science and Engineering Division





Materials Science

Material chemistry & physical properties testing

Product Testing & Validation

Accelerated life cycle testing

Regulatory & industry-based validation testing

Winter Proving Ground

Vehicle system validation

Snow & ice traction testing

Product launch & demo events

Technical Consulting

Failure analysis

Benchmarking & performance analysis

Tire Testing for California's Replacement Tire Efficiency Program

Agenda

- Objective
- Background
- Test Procedures
- Tire Selections and Sourcing
- Results
  - Test Data
  - Correlation Studies

Tire Testing for California's Replacement Tire Efficiency Program

Objective

The objective was to assist the Pacific Gas and Electric Company ("PG&E"), in consultation with the California Energy Commission ("CEC"), in understanding a California focused tire population regarding both rolling resistance and wet traction.

Tire Testing for California's Replacement Tire Efficiency Program

Background

- Smithers MSE Inc. was contracted to provide rolling resistance testing, tire technology consultations and project management to the Pacific Gas and Electric Company, in consultation with the California Energy Commission regarding the Replacement Tire Efficiency Program.

- The Pacific Gas and Electric Company, in consultation with the California Energy Commission, purchased a variety of passenger car and light truck tires and submitted them to Smithers MSE for testing, and assistance in studying any correlations between rolling resistance and other tire characteristics

Tire Testing for California's Replacement Tire Efficiency Program

Background: Smithers Role

- Document tire identifications: including sizes, manufacturers, design names, SKU (stock keeping unit) labels, and stamping information.
- Conduct measurements including tire weights and tread depths.
- Testing:
  - Four (4) tires each of 149 unique tire SKUs were submitted for testing.
  - Three (3) tires per SKU (total 447 tires) were tested for rolling resistance
  - One (1) tire per SKU (total 149 tires) was tested for wet traction.
- Study correlations between rolling resistance, wet traction and a number of other tire parameters.

Tire Testing for California's Replacement Tire Efficiency Program

Procedures

- Terminology
- Test Protocols

Tire Testing for California's Replacement Tire Efficiency Program

Terminology

Rolling Resistance	The force at the axle in the direction of travel required to make a loaded tire roll.
Rolling Resistance Coefficient RRC	RRC = F/G, where F is the force necessary to pull the axle of a tire horizontally in the direction of travel, and G is the vertical load on the tire which is assumed to roll on a flat horizontal surface.[1]

[1] Applied Dimensional Analysis and Modeling (Second Edition), 2007

Tire Testing for California's Replacement Tire Efficiency Program

Terminology

Wet Traction	The ability of a loaded tire to generate vehicle control forces through frictional interaction with a wet road surface.[1]
Wet Traction Index	The wet grip index of the candidate tyre *G*(T*n*) represents the relative wet grip performance index of the candidate tyre T*n* (*n*=1, 2, etc.) compared to the reference tyre.

[1]Tires and Passenger Vehicle Fuel Economy: Informing Consumers, Improving Performance, TRB Special Report 286
[2] ISO 23671(2021) Method for measuring relative wet grip performance — Loaded new tyres

Tire Testing for California's Replacement Tire Efficiency Program

Test Procedure: Rolling Resistance

Test Protocol	**ISO 28580:2018 "Passenger Car, Truck and Bus Tyre Rolling Resistance Measurement Method — Single Point Test and Correlation of Measurement Results."**
Laboratory Certification	ISO 17025
Number SKUs Tested	149 (447 tires total)
Description	ISO 28580:2018 specifies methods for measuring rolling resistance, under controlled laboratory conditions, for new pneumatic tires designed primarily for use on passenger cars, trucks and buses. Measurement of tires using this method enables comparisons to be made between the rolling resistance of new test tires when they are free-rolling straight ahead, in a position perpendicular to the drum outer surface, and in steady-state conditions.

Tire Testing for California's Replacement Tire Efficiency Program

Test Procedure: Rolling Resistance

Tire Testing for California's Replacement Tire Efficiency Program

Test Procedure: Rolling Resistance

EU Rolling Resistance Correlation

Smithers worked with a partner to develop a correlation to the EU virtual machine used for European Labeling.

EU Correlation: L2 RRC = 0.9605 x SmithersMC – 0.3828

Validity period: **Correlation Valid Through 31st of Dec 2023**

- The rolling resistance coefficient corrections, within the ranges studied, range from: -0.63 to -0.86.

- The candidate Smithers Lab machine is a test position dedicated for C1 and C2 tire classes.
- The reference machine MC#04.A (correlation machine) is a test position dedicated for C1 and C2 tire classes.

Tire Testing for California's Replacement Tire Efficiency Program

Test Procedure: Wet Traction

Test Protocol	**ISO 23671:2021** **"Passenger Car Tyres - Method for Measuring Relative Wet Grip Performance - Loaded New Tyres" (Trailer method)**
Number Tires Tested	One (1) tire per SKU ; 149 total SKUs
Description	ISO 23671:2021 specifies the method for measuring relative wet grip braking performance index to a reference under loaded conditions for new tires for use on passenger cars on a wet-paved surface.

Tire Testing for California's Replacement Tire Efficiency Program

Test Procedure: Wet Traction

Tire Testing for California's Replacement Tire Efficiency Program

Tire Selections and Sourcing

- Tire SKUs were chosen by the California Energy Commission
- Smithers MSE was advised that the selections were made with consideration to the sizes and types of tires typically used on a variety of the highest volume types of vehicles in current California usage with respect to vehicle manufacturing year and brand.
- Decisions were based upon vehicle licensure information.
- The Pacific Gas and Electric Company, in consultation with the California Energy Commission, purchased the variety of passenger car and light truck tires and submitted them to Smithers MSE for testing.

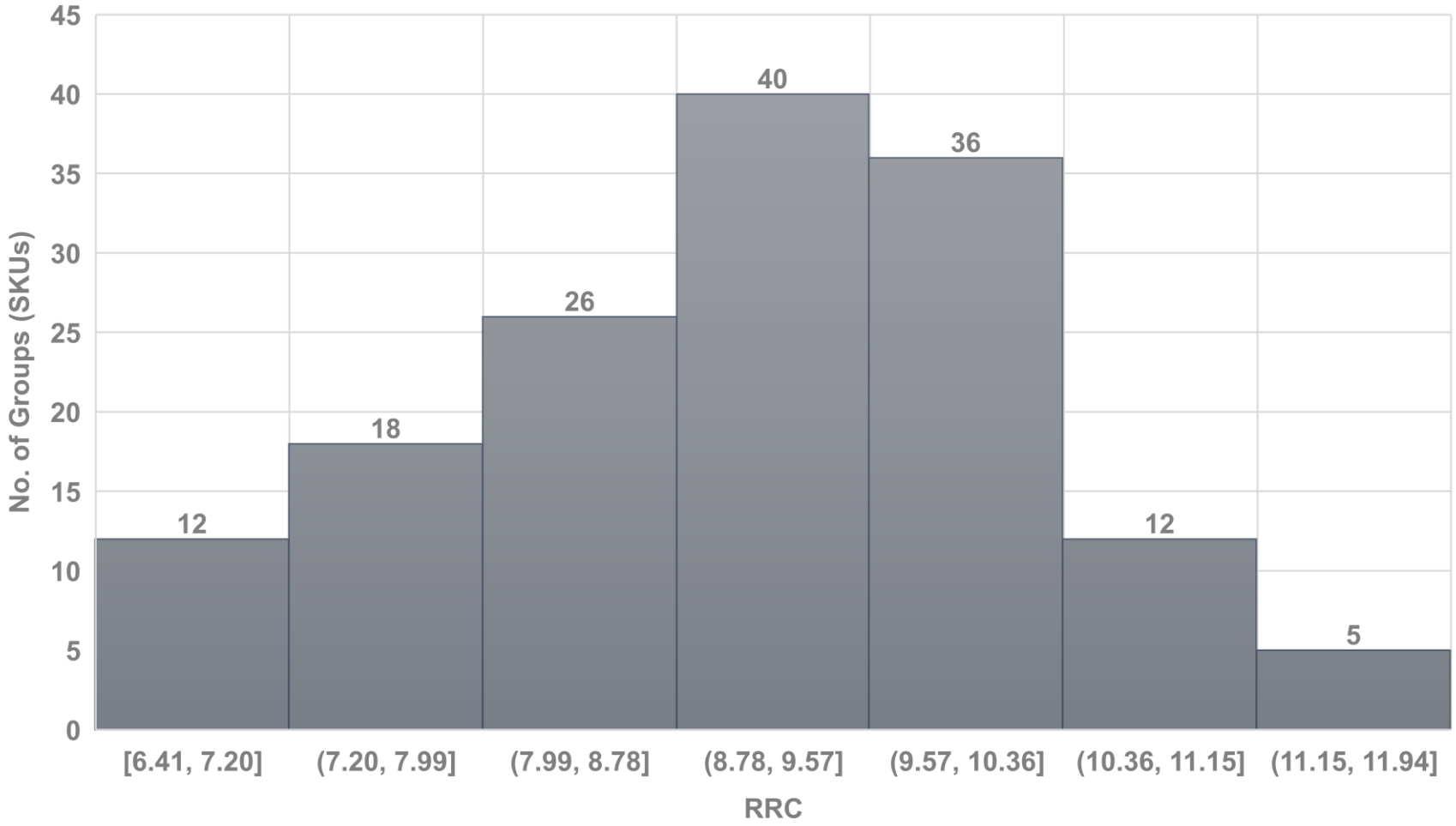
Tire Testing for California's Replacement Tire Efficiency Program

Results: Descriptive Statistics

	Population By Set (SKU)
Sample Size	149 (3-tire avgs.)
Average Mean	9.04
Average Median	9.04
Average Standard Deviation	0.099
Average Coefficient of Variation	1.1%

Tire Testing for California's Replacement Tire Efficiency Program

Results: SKU Frequency by RRC Range



Tire Testing for California's Replacement Tire Efficiency Program

Results: Correlation Studies

Wet Grip vs Rolling Resistance

UTQG Traction vs Rolling Resistance

UTQG Treadwear vs Rolling Resistance

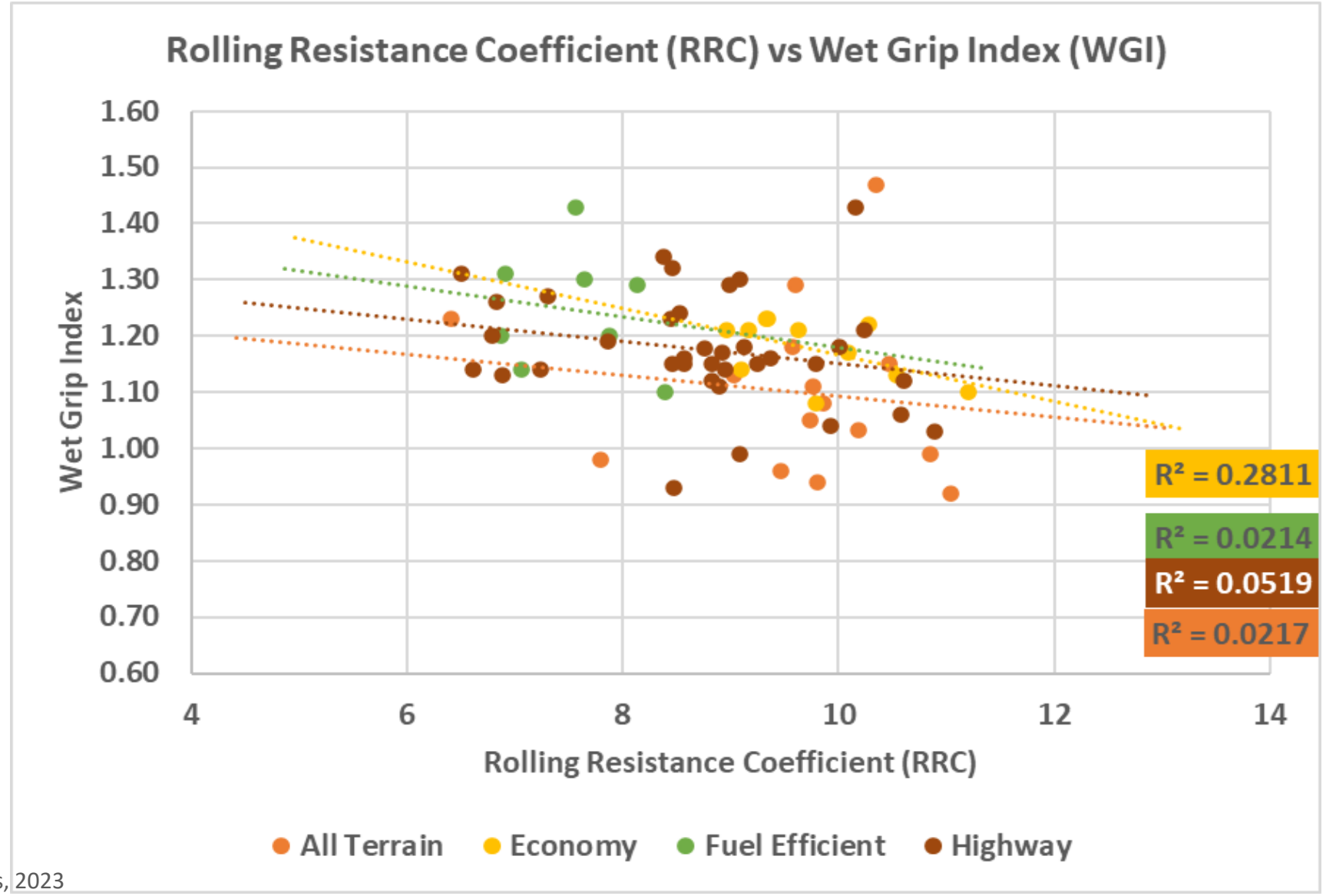
Tire Price vs Rolling Resistance

Tread Depth vs UTQG Rolling Resistance

Tire Market Category vs Rolling Resistance

OE vs Replacement Rolling Resistance: Example Size

Tire Testing for California's Replacement Tire Efficiency Program



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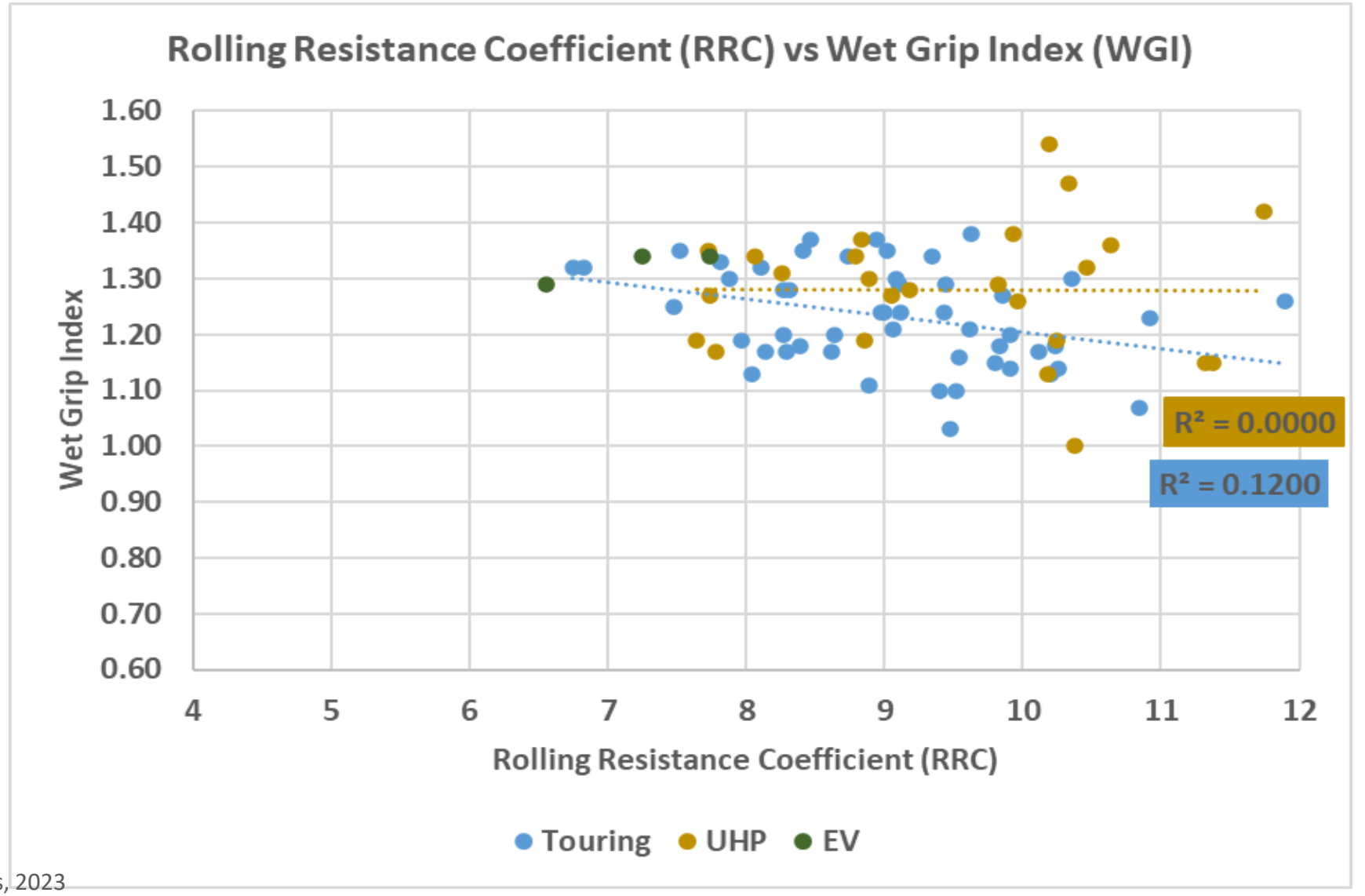

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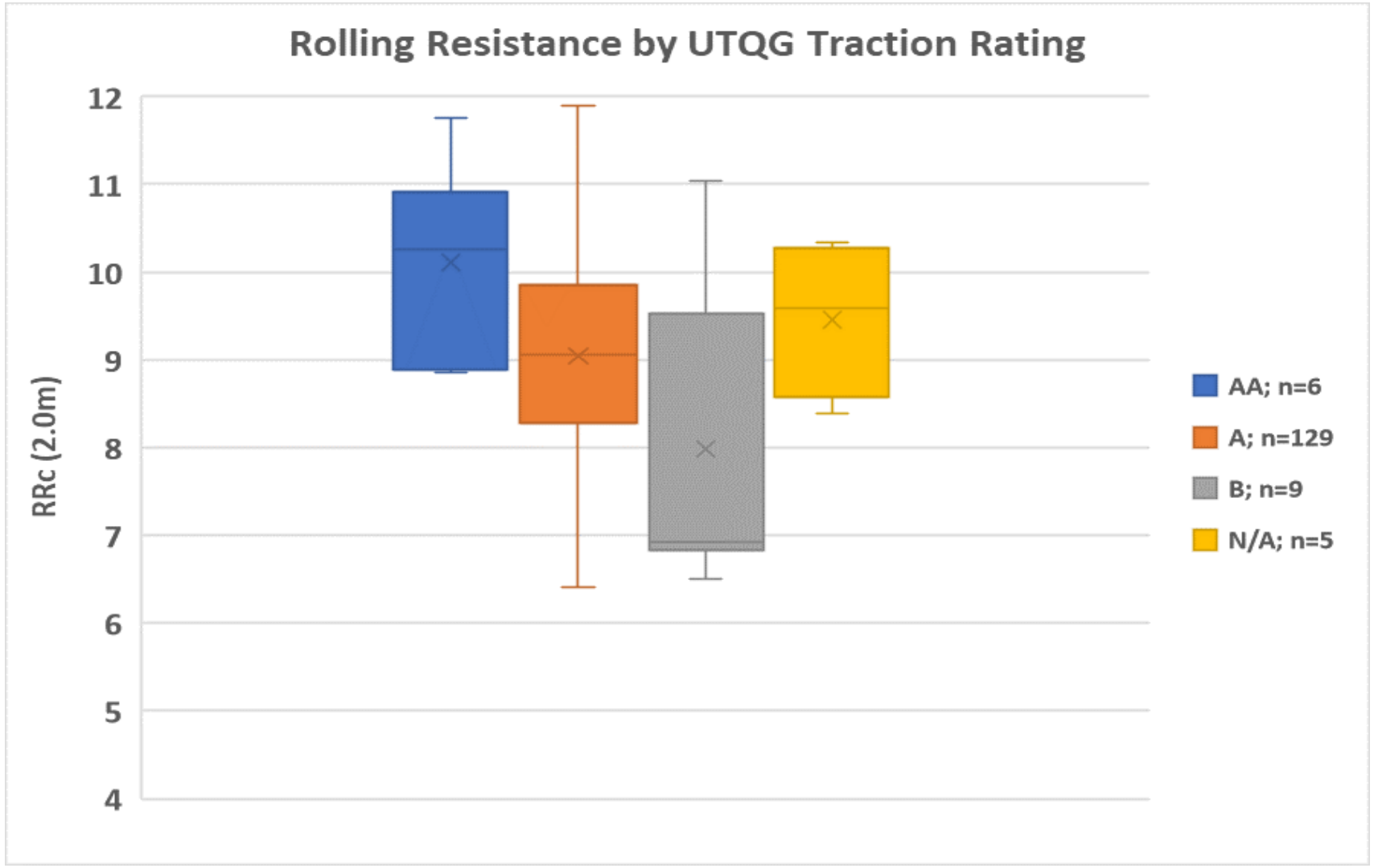

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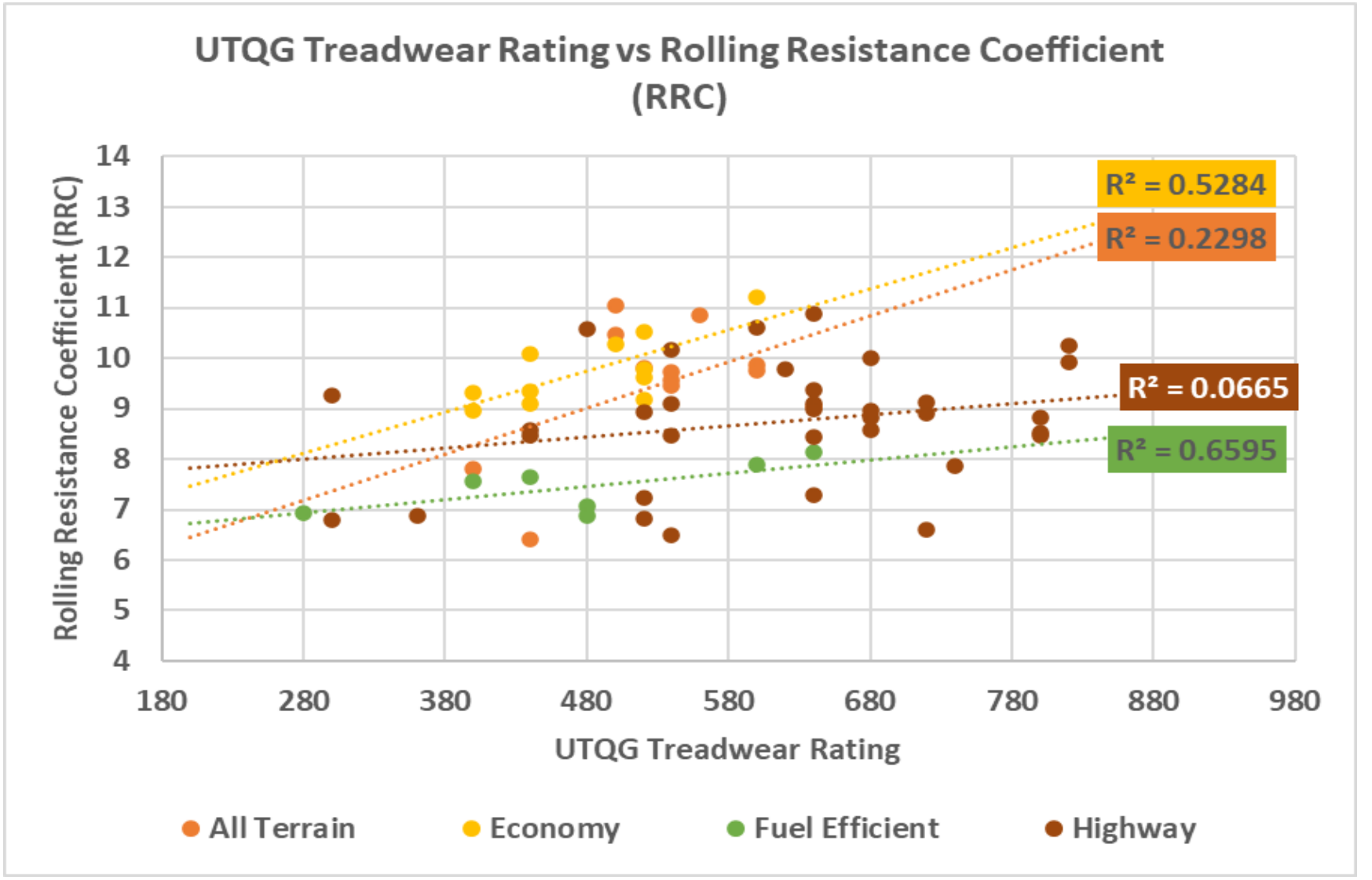

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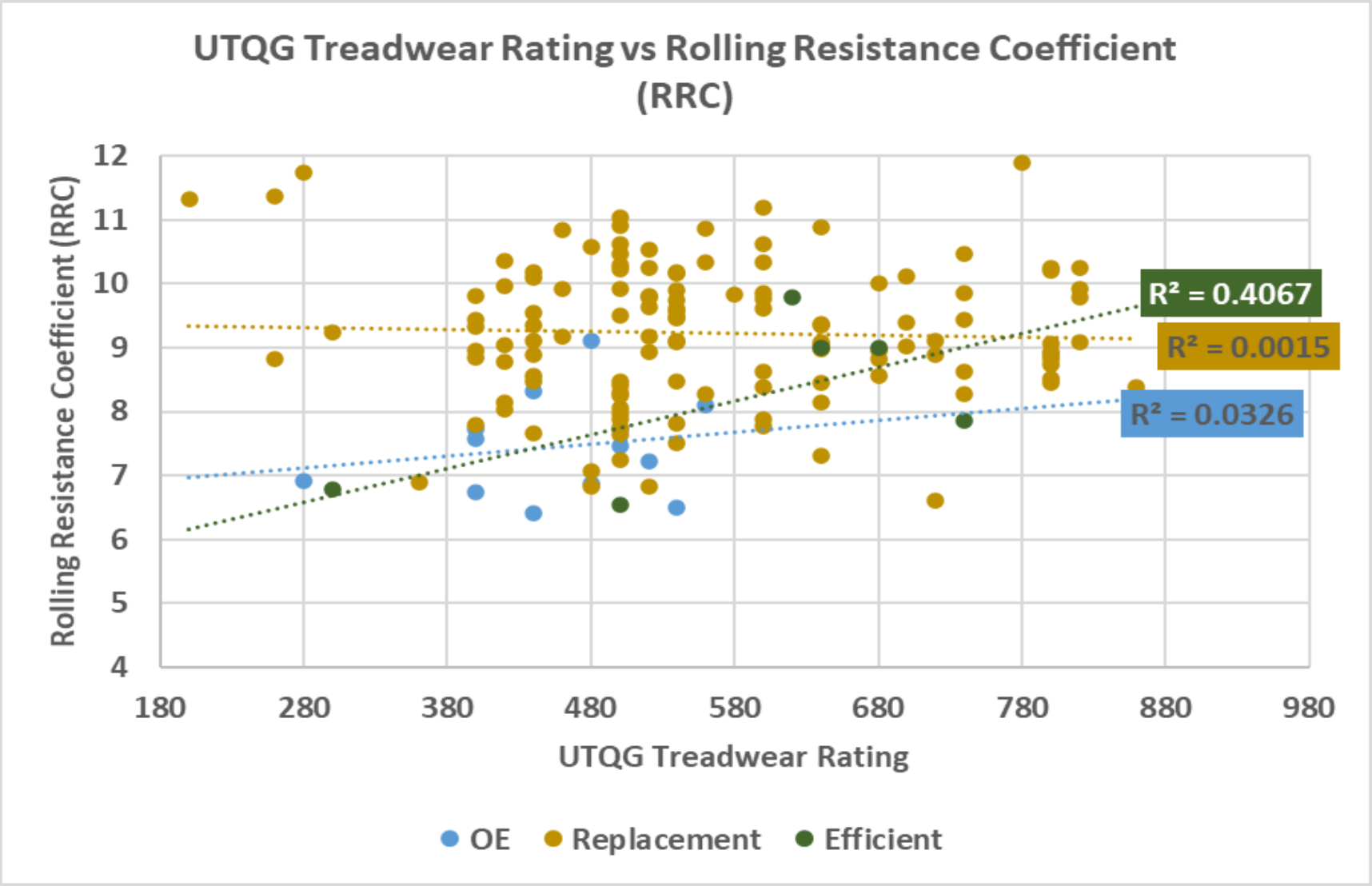

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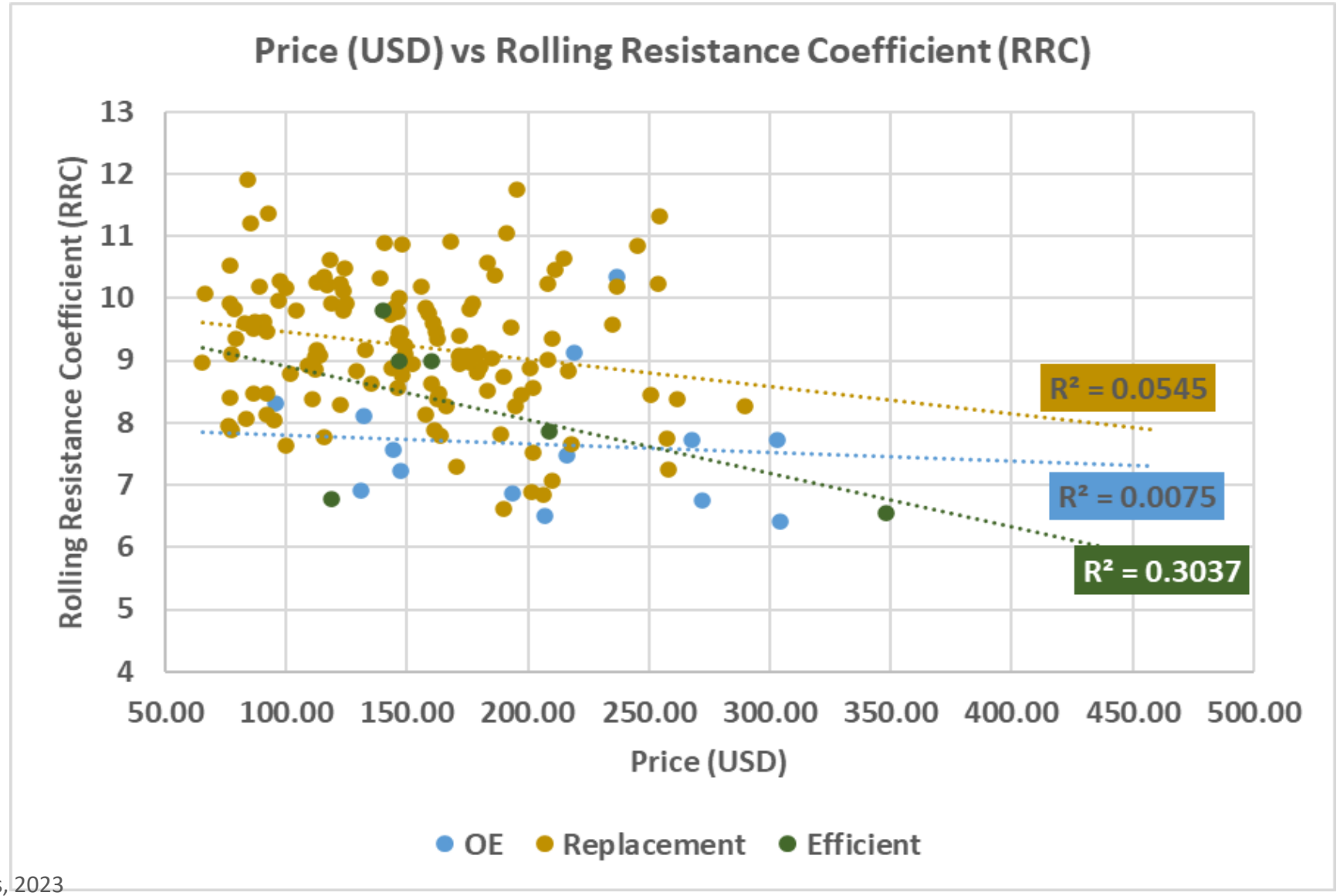

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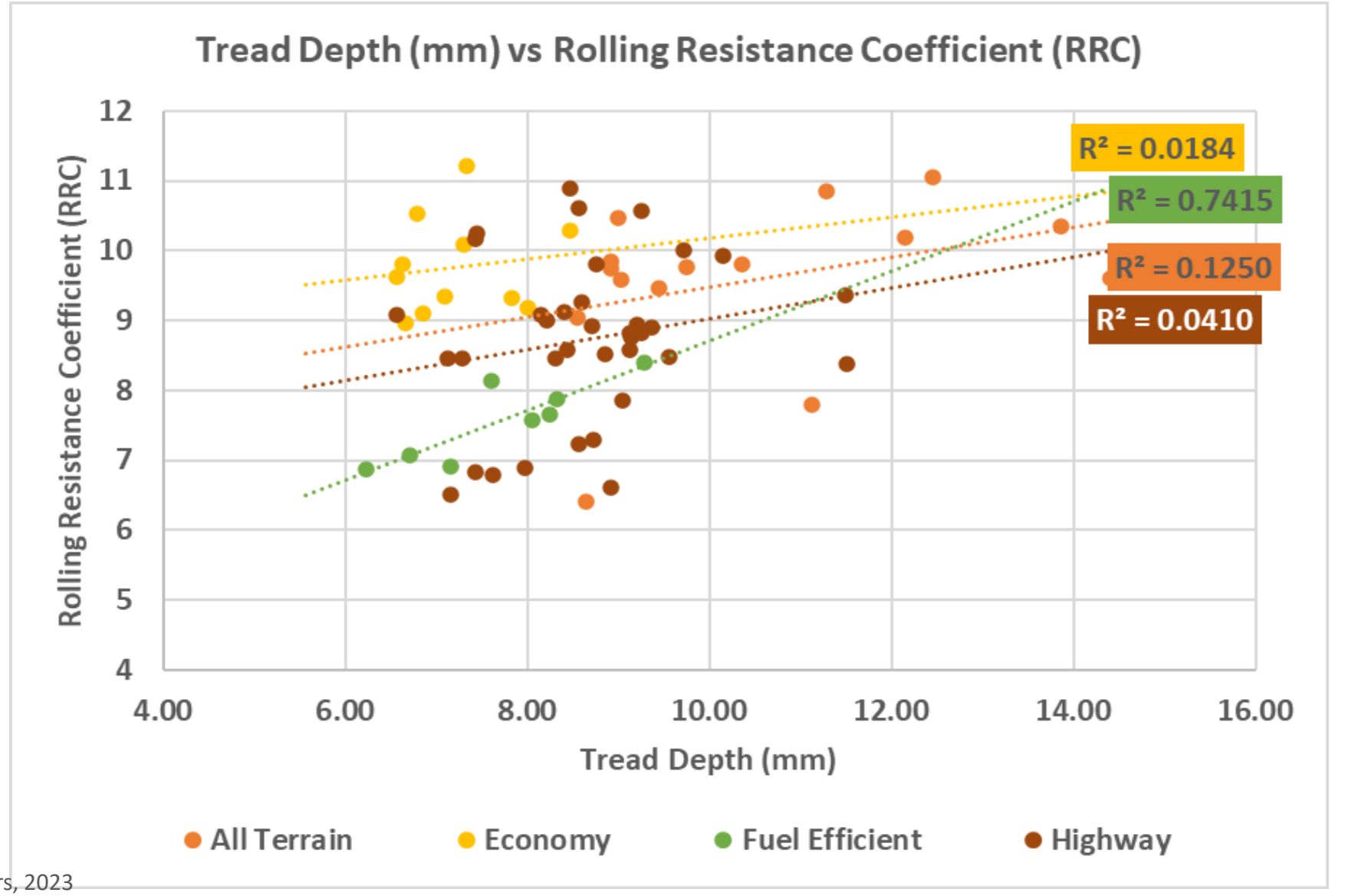

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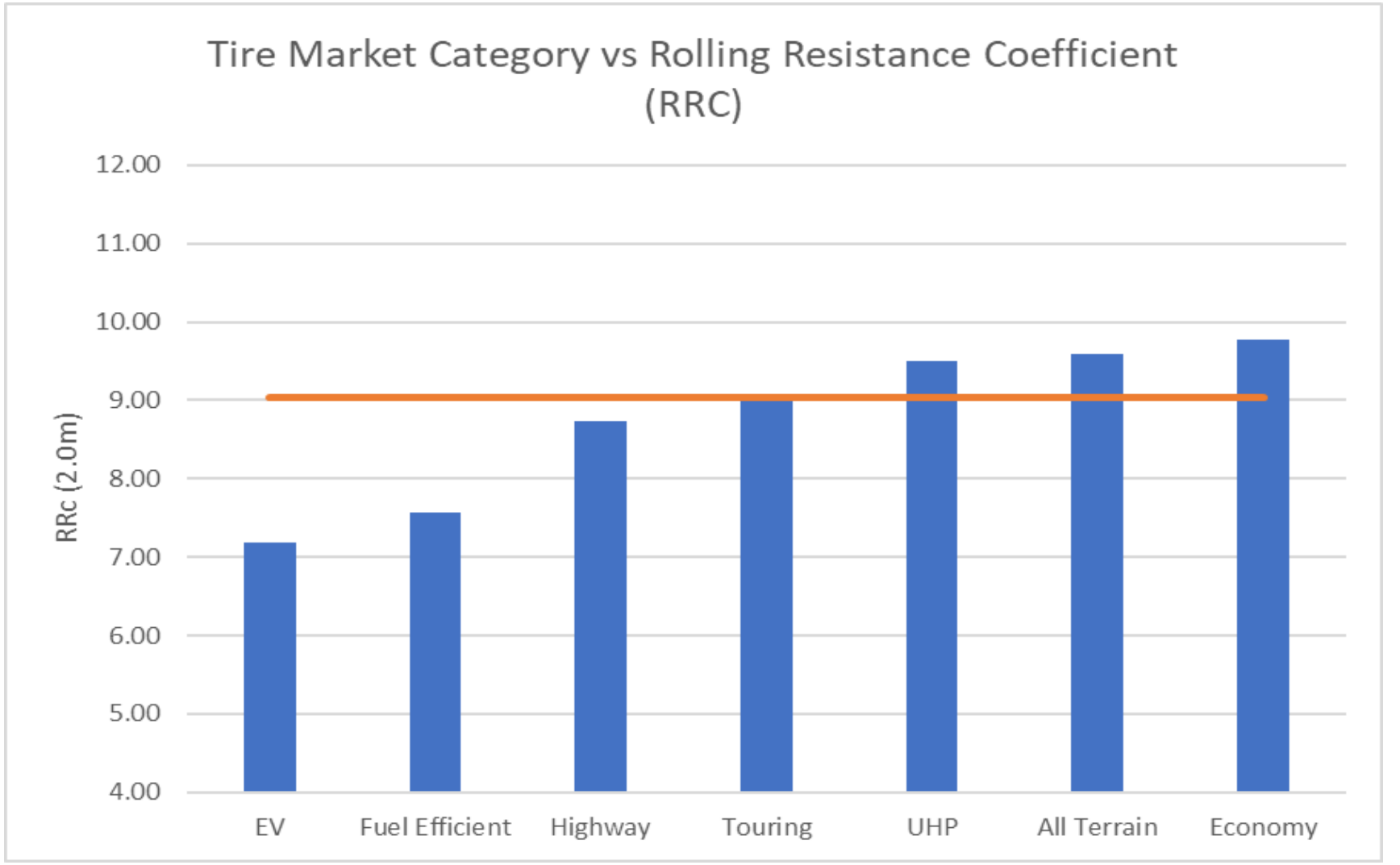

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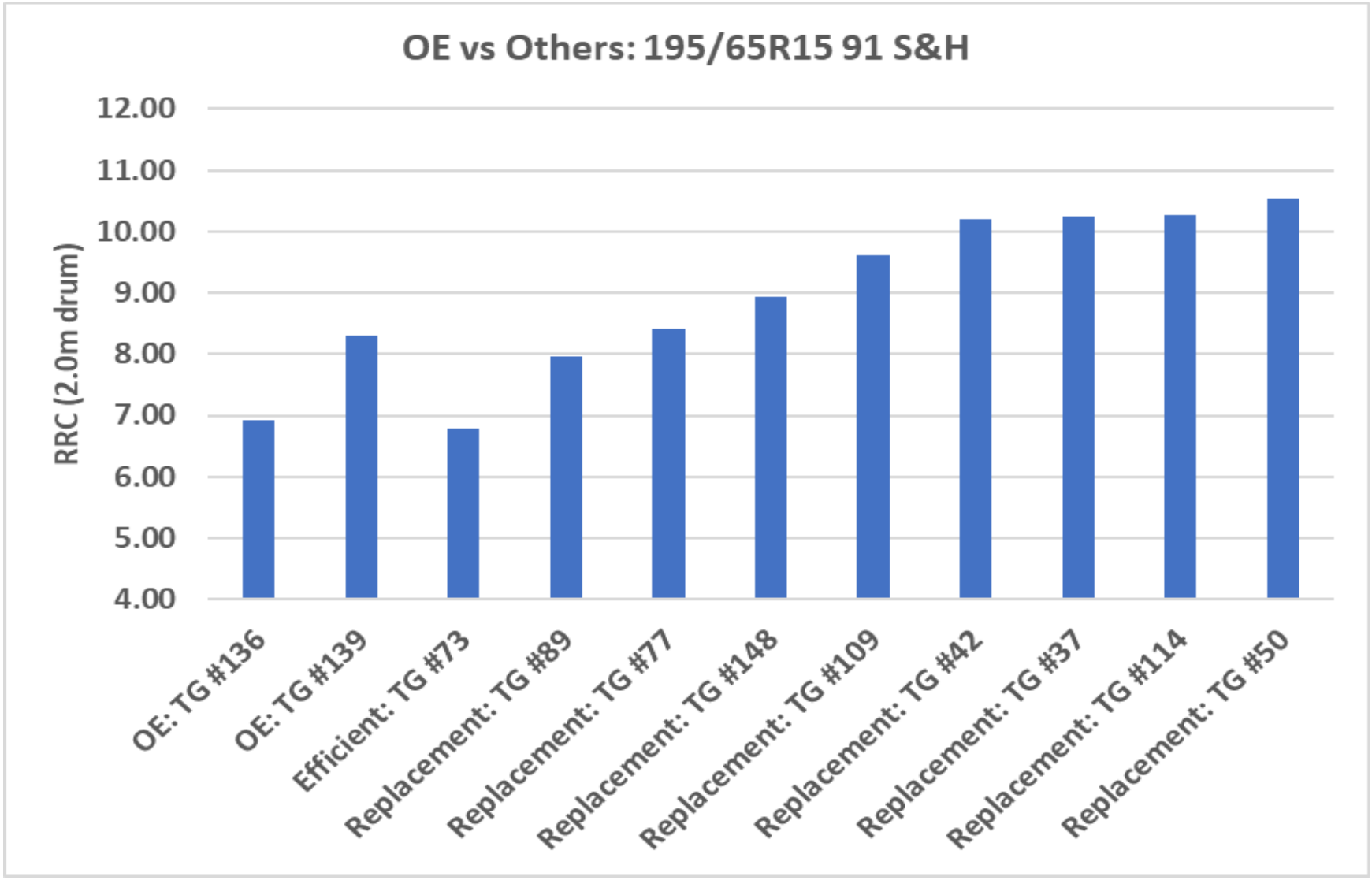

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Tire Testing for California's Replacement Tire Efficiency Program

Results: Tests

Test Data Example Formats

Descriptive Statistics

Distribution of RRC Results

Tire Testing for California's Replacement Tire Efficiency Program

Test Data: Information Categories Reported

Rolling Resistance Data

Smithers Group ID	Smithers Tire ID	Tire Size	Load Index	Speed Rating	Tread Depth (mm)	Tire Weight (lbs)	RR Force (N)	RRC (2.0 meter)	Price ($)
1	2202737	P245/75R16	109	T	7.94	33.0	73.7	9.12	113.01
1	2202738	P245/75R16	109	T	7.94	33.5	74.7	9.24	113.01
1	2202739	P245/75R16	109	T	7.94	33.1	74.1	9.16	113.01
2	2202731	P255/70R17	110	T	10.32	37.9	80.0	9.62	143.42
2	2202732	P255/70R17	110	T	10.32	39.1	82.6	9.93	143.42
2	2202733	P255/70R17	110	T	10.32	38.2	80.5	9.68	143.42
3	2202758	225/65R17	102	T	7.94	27.5	63.6	9.53	145.96
3	2202759	225/65R17	102	T	7.94	27.4	61.8	9.26	145.96
3	2202760	225/65R17	102	T	7.94	27.3	61.3	9.19	145.96

Tire Testing for California's Replacement Tire Efficiency Program

Test Data: Information Categories Reported

Wet Traction Index Data

Smithers Group ID	Smithers Tire ID	Tire Size	Load Index	Speed Rating	Tread Depth (mm)	Tire Weight (lbs)	Wet Grip	Price ($)
1	wet-1	P245/75R16	109	T	8.00	33.3	1.21	113.01
2	wet-2	P255/70R17	110	T	8.92	38.1	1.05	143.42
3	wet-3	225/65R17	102	T	7.83	27.2	1.23	145.96

Tire Testing for California's Replacement Tire Efficiency Program

Test Data: Information Categories Reported

Other Tire Group Information

Smithers Group ID	Tire Size	UTQG Treadwear	UTQG Traction	UTQG Temperature	Tire Market Category	Tire Usage Category	Manufacturer Tier	Run Flat (Y/N)
1	P245/75R16	520	A	B	Economy	Replacement	3	N
2	P255/70R17	540	A	A	All terrain	Replacement	3	N
3	225/65R17	400	A	B	Economy	Replacement	1	N

