TRB-NAS Special Report #286 “Tires and Passenger Vehicle Fuel Economy”

VSR Analysis

NHTSA Involvement

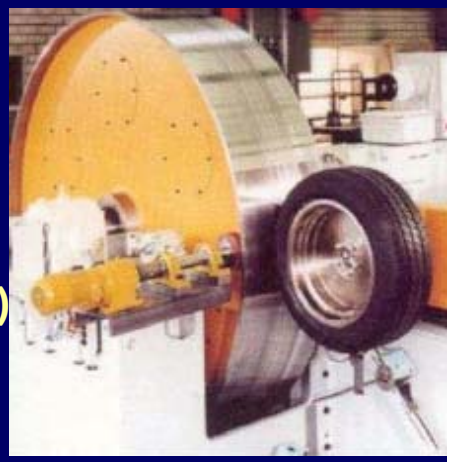
- **$500k in project funding provided by and administered by the agency**
  - VSR provided COTRs and technical support
- **Various personnel from the agency met with committee and its members**
  - Travel budget limitations prevented an agency representative from being present at all meetings
- **Committee acknowledged contributions from Ronald Medford, Joseph Kanianthra, W. Riley Garrott, NHTSA COTRs.**
  - Riley Garrott Ph.D. presented “Overview of VRTC Crash Avoidance Research and Tire Safety Studies”

Study Charge and Scope

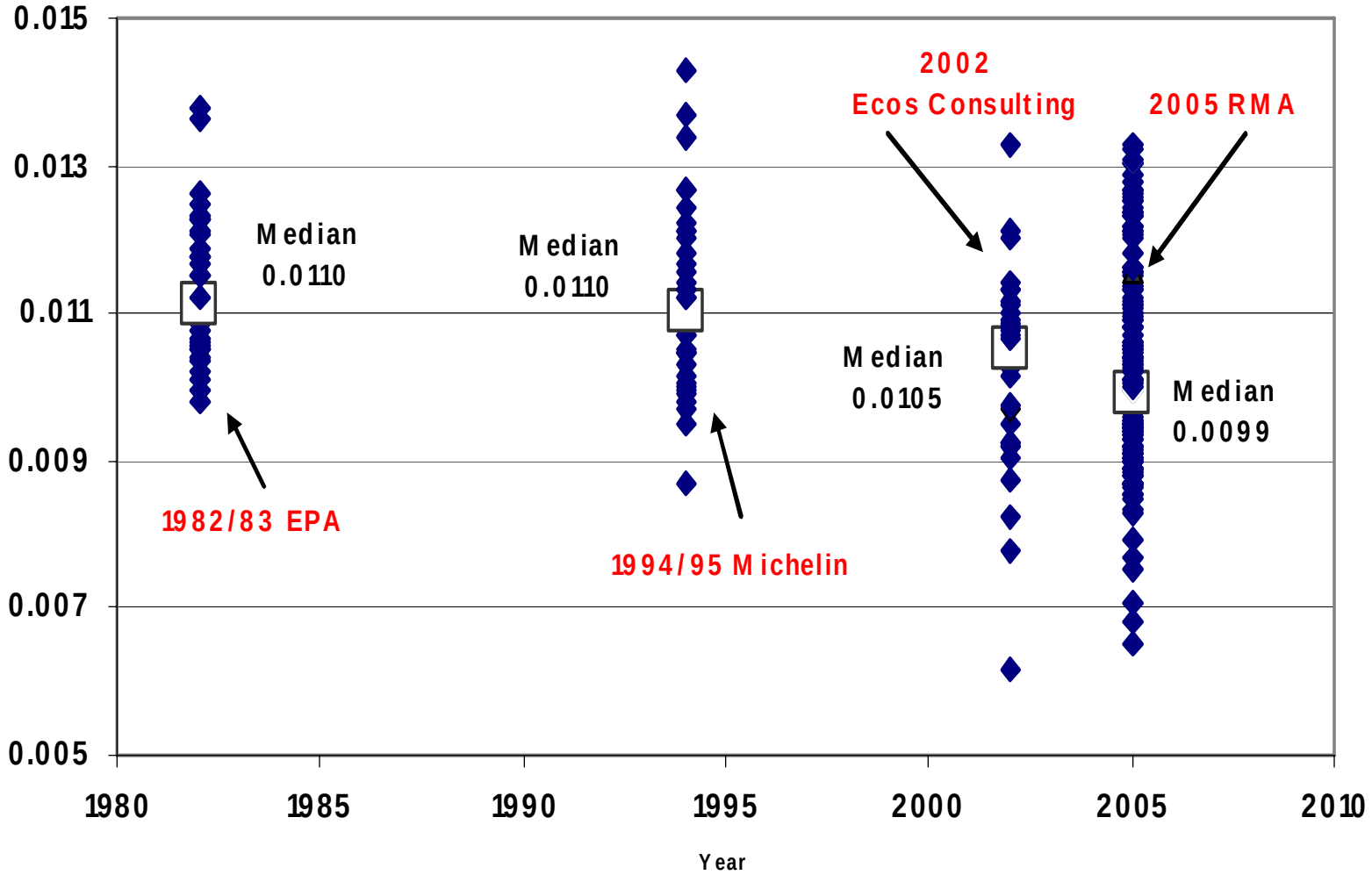
- **"Evaluate how lowering the rolling resistance of replacement tires used on passenger cars and light trucks could affect:**
  - Motor fuel consumption nationally;
  - Tire wear life and the generation of scrap tires;
  - Tire performance characteristics, including those affecting vehicle safety; and
  - Total consumer spending on tires and fuel."

Measuring Rolling Resistance

- **Rolling Resistance Coefficient ("RRC") is the value of the rolling resistance force divided by the wheel load**
  - The higher the RRC value, the worse the rolling resistance
  - A RRC of 0.0100 = 40 lb of rolling resistance force opposing a 4,000 lb car
  - RRC is typically measured for new tires only
- **2005 RMA RRC Data (measured via SAE J1269)**
  - OE Passenger Tires
    - Range: 0.0070 to 0.0095, **Average 0.00838**
  - Replacement Passenger Tires
    - Range: 0.0065 to 0.0133, **Average 0.01020 (22% higher)**
- **SAE Test Procedures**
  - J1269 (Single speed – 50 mph)
    - Used primarily to assign a rolling resistance value to a tire
  - J2452 (Range of speeds)
    - Used primarily to characterize average tire rolling resistance during typical driving cycles for vehicle emission and fuel economy calculations



Rolling Resistance of Replacement Tire Samples, 1982 to 2005



Summary of TRB-NAS Conclusions

"*A recommendation for congressional action is offered in light of the following conclusions*." TRB-NAS

TRB-NAS Conclusion #1

- **Feasibility of lowering rolling resistance in replacement tires**
  - Conclusion #1: "Reducing the average rolling resistance of replacement tires by a magnitude of 10 percent is technically and economically feasible."
    - The committee found that OE tires have lower rolling resistance by 10 to 25 percent across all classes of passenger vehicle tires
    - Tire designs could be modified, new tire technologies adopted or introduced, and better tire inflation pressure maintenance could further this outcome
    - Results should be attainable within a decade

TRB-NAS Conclusion #2

- **Influence on Vehicle Fuel Economy**
  - Conclusion #2: "Tires and their rolling resistance characteristics can have a meaningful effect on vehicle fuel economy and consumption."
    - 10% reduction in the average rolling resistance of replacement tires promises a 1 to 2% increase in the fuel economy of passenger vehicles, saving about 1 to 2 billion gallons of fuel per year nationwide*
    - *VSR Comment:* It is estimated that the "Unreformed CAFE approach" will save 5.4 billion gallons of fuel over the lives of the vehicles (approximately 26 years) and the "Reformed CAFE approach" will save 10 billion gallons.** That's 0.21 or 0.38 billion gallons per year nationwide.
    - A 10% reduction in replacement tire rolling resistance can save 2.6 to 9.5 times as much annual fuel as the proposed CAFE upgrades

*Four separate simulation models, provided by General Motors, National Energy Technology Laboratory, University of Michigan, and Environmental Energy Analysis, confirm this conclusion.
**Source: NPRM - Average Fuel Economy Standards for Light Trucks

TRB-NAS Conclusion #3

- **Effects on Tire Wear Life and Scrap Tires**
  - Conclusion #3: "The effects of reductions in rolling resistance on tire wear life and scrap tires are difficult to estimate because of various ways by which rolling resistance can be reduced."
    - Continuing advances in tire technology hold much promise that rolling resistance can be reduced further without adverse effects on tire wear life and scrap populations
    - However, a reduction of new-tire tread depth of 2/32 (20%) will also result in an approximate reduction in rolling-resistance of 10%. Though it's unlikely that companies would follow this approach due to diminished customer satisfaction, it would have implications:
      - A 2/32-inch change in tread depth would result in a change in UTQG treadwear of 40 points, or about 10% for the average tire in the dataset
      - A 10% reduction in tire wear life costs consumers about $12 more per year in added tire expenses because of more frequent tire replacement. The average annual fuel savings estimates ($12 to $24) could be negated.

TRB-NAS Conclusion #4

- **Effects on Traction and Safety Performance**
  - Conclusion #4: "Although traction may be affected by modifying a tire's tread to reduce rolling resistance, the committee could not find safety consequences. Such consequences may be undetectable."
    - Many tires in the replacement market have UTQG "A" wet traction rating and rolling resistance >10% below average
    - *VSR Comments:*
      - Analysis is based on NHTSA UTQG wet traction measurements, which are general categories not actual friction numbers
      - VSR is concerned about tire manufacturers maintaining sufficient dry traction not just for stopping distance but also for limit handling
      - If reductions in tread depth are used to achieve lower rolling resistance rather than improvements to tread compounds, there would be negative implications for wet and snow traction (i.e. safety)
      - A comprehensive tire traction test may have to be implemented to assure low-cost manufacturers do not trade traction for lower rolling resistance

TRB-NAS Conclusion #5

- **Effects on Consumer Fuel and Tire**
  - Conclusion #5: "Reducing the average rolling resistance of replacement tires promises fuel savings to consumers that exceed associated tire purchase cost, as long as tire wear life is not shortened."
    - About 80% of passenger cars and light trucks are equipped with replacement tires
    - A 10% reduction in rolling resistance can save to 6 to 12 gallons per year for typical vehicles, or <u>$12 to $24</u> if fuel is priced at $2 per gallon
    - The tire technologies today necessary to achieve the 10% reduction would cost consumers on the order of <u>$1 to $2 per year</u>
    - The committee observes that consumers currently have little, if any, practical way of assessing how tire choices can affect vehicle economy

TRB-NAS: HOW WILL CONSUMERS RESPOND?

- **"[The Committee] doesn't know how individual consumers will respond**
  - Each will weigh costs and savings differently
  - No major price differences observed among similar tires with different RR
  - Perhaps information will spur interest in this characteristic?
  - CONSUMER INFORMATION IS NOT AVAILABLE TODAY
  - If RR is lowered on average, it is likely to result from some combination of changes in:
    - Mix of tires purchased by consumers
    - Technology
    - Consumer behavior in maintaining inflation pressure"

Summary of NAS Recommendations and Implications to the Agency

Recommendation #1

- **Development of a standard measure of tire's effect on fuel economy averaged over its anticipated lifetime of use (as opposed to only when new) deserves consideration.**
- **Implication**
  - Rolling resistance will typically decline by more than 20% over the service life of a tire, with the rate of change varying from one design to another. Current test methods only evaluate new tires. The recommendation suggests research should be conducted to develop a test that estimates a tire's average lifetime rolling resistance.

Recommendation #2

- **"Congress should authorize and <u>make sufficient resources available to NHTSA</u> to allow it to gather and report information on the influence of individual passenger tires on vehicle fuel consumption.**
  - The effort should cover a large portion of the passenger tires sold in the United States and be comprehensive with regard to popular sizes, models, and types, both imported and domestic."
- **Implication**
  - There are literally tens of thousands of replacement tire model-size combinations on which NHTSA would be responsible for disseminating rolling resistance data

Recommendation #3

- **"NHTSA should consult with the U.S. EPA on means of conveying the information and ensure that the information is made widely available in a timely manner and is easily understood by both buyers and sellers.**
  - In the gathering and communication of this information, the agency should seek the <u>active participation</u> of the entire tire industry."
- **Implication**
  - The International Energy Agency and others have recognized the effectiveness of the EPA's Energy Star Program and have postulated similar programs for tires. What "active participation" of the tire industry entails was not specified.

Recommendation #4

- **The effectiveness of this consumer information and methods used for communicating it should be reviewed/revised regularly**
  - Congress should require periodic assessments of the initiative's utility to consumers, the level of cooperation by industry, and the resultant contribution to national goals pertaining to energy consumption
- **Implication**
  - Suggests that Congress should require (most likely of the agency or NAS) periodic assessments of the effectiveness of said program. May take require additional agency resources.

Recommendation #5

- **"Motorist must be alerted to the fact that even small losses in inflation pressure can greatly reduce tire life, fuel economy, safety, and operating performance.**
  - A strong message urging vigilant maintenance of inflation must therefore be a central part of communicating information on the energy performance of tires to motorist."
- **Implication**
  - As agency requirements for light vehicle tire pressure monitoring are phased-in, it will aid tire pressure maintenance and indirectly tire efficiency
  - The above recommendation suggests the agency continue and perhaps expanded consumer information and advisories on tire maintenance
  - NHTSA may wish to study Tire Inflation Systems for commercial vehicles, which on average travel 5 times the annual mileage of a passenger vehicle

Overall VSR Concerns

- TRB-NAS Statement "There is a near absence of studies of the effect of tire traction on motor vehicle crashes."
- All 2002 or newer tires in the study were from Michelin, Bridgestone, or Goodyear tire lines or their affiliated brands*. No tires from Cooper, Denman, etc. (SBA concerns).
- TRB-NAS Study excluded light truck (15% of replacement market) and snow tires (4.2% of replacement market). This leaves the agency with a large gap in the analysis.
- The recent trend towards higher speed rated and runflat** tires tires in the replacement market, which have higher average rolling resistance, may offset future rolling resistance gains
- Results analyzed by the committee were from SAE J1269 test, which is used primarily by the tire industry. Vehicle manufacturers tend to use SAE J2452. The agency would need to evaluate which method best meets the our needs.
- Any decisions should await the December, 2006 California Energy Commission study results (150 tires to be tested, both SAE methods evaluated, tread wear, etc.)

*Name brand (Michelin, Bridgestone, Goodyear) or affiliated brands (Uniroyal, Firestone, BF Goodrich)
**With the exception of the Michelin PAX runflat system

Overall VSR Concerns

- **Rolling resistance testing is expensive, lengthy, and testing capacity is limited**
- **There are tens of thousands of replacement tire model-size combinations**
- **Without self-reporting from manufacturers, the resources required and the expense of a program to "cover a large portion of the passenger tires sold in the United States" (TRB-NAS recommendation) would be extraordinary**
  - The California Energy Commission's study of approximately 150 tire model-size combinations (1400 tires) had an estimated budget of $700k and a two year timeframe

NAS Data Sources

- **Data sources used in the study:**
  - Replacement tire data sources:
    - EPA 1982-83, 36 tires (all P195/75R14)
    - Michelin 1994, 37 tires (sizes not given)
    - Michelin 1995, 6 tires (all 15 inch)
    - Ecos Consulting 2002, 34 tires (14-16 inch)
      - Several manufacturers
    - RMA late 2005, 154 tires (13-22 inch)
      - 91 Michelin tires*, 19 Bridgestone tires, 10 Goodyear tires
  - OE tire data sources:
    - Michelin 1994, 9 tires (sizes not given)
    - Michelin 1995, 24 tires (13-16 inch)
    - RMA late 2005, 8 tires (13-22 inch)
      - 5 Bridgestone tires & 3 Goodyear tires