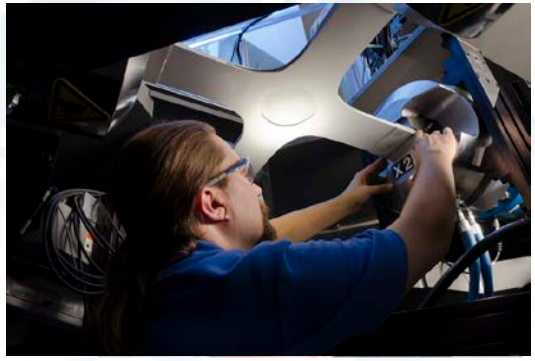


A Model For Working With Manufacturers – NIST Center for Automotive Lightweighting

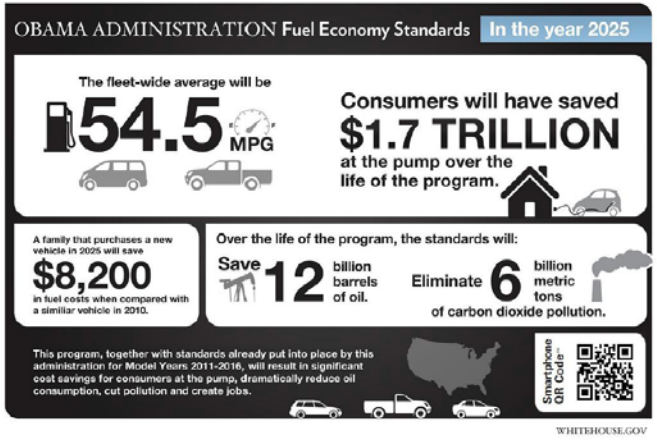
Tim Foecke, Director

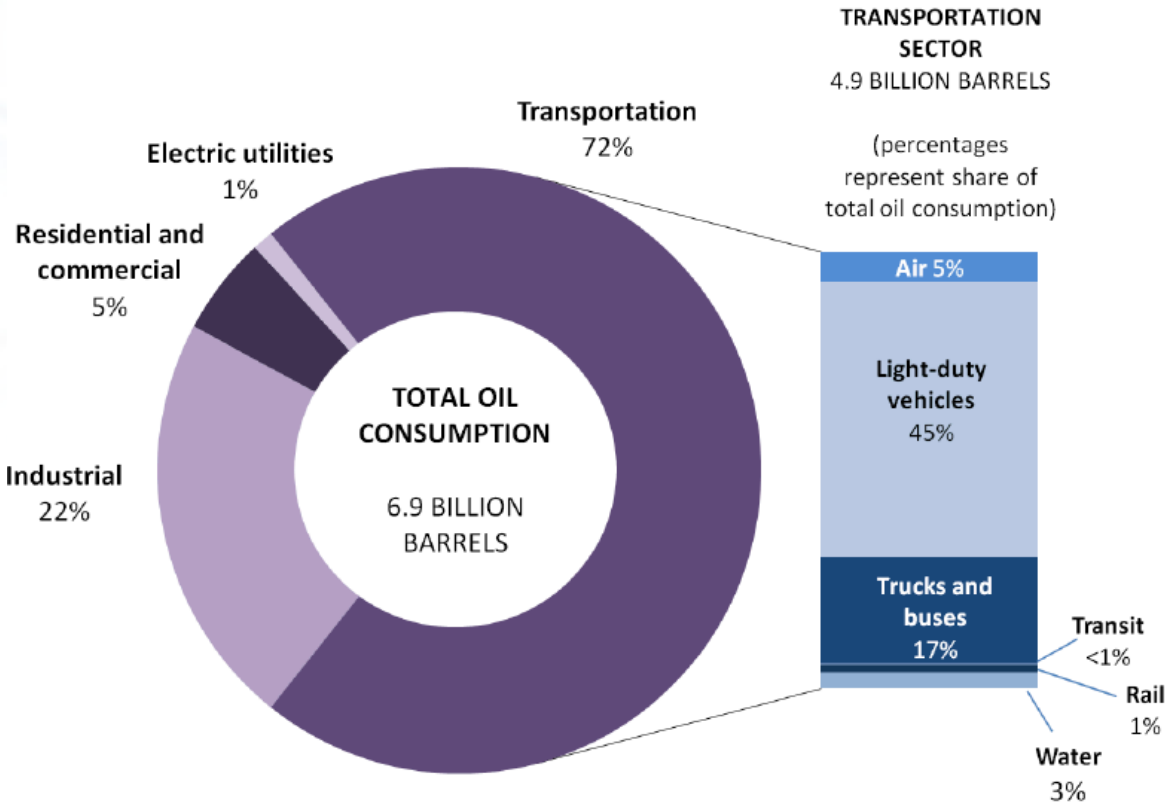
National Institute of Standards and Technology
U.S. Department of Commerce

MATERIAL MEASUREMENT LABORATORY

The US Automotive Industry

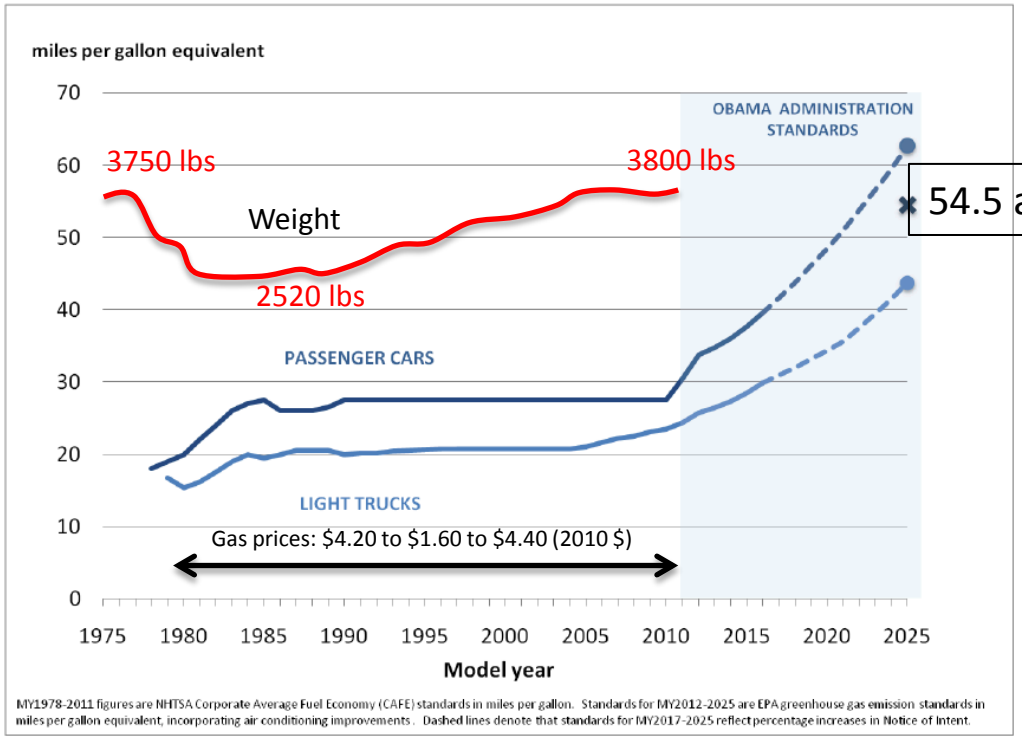
- Is a HUGE part of the GDP, and improving CAFE has multi-benefits
- Is primarly driven by cost, but also by government regulation
  - Crashworthiness, Roll-over, CAFE





From the newly-released White House report.

The US Automotive Industry



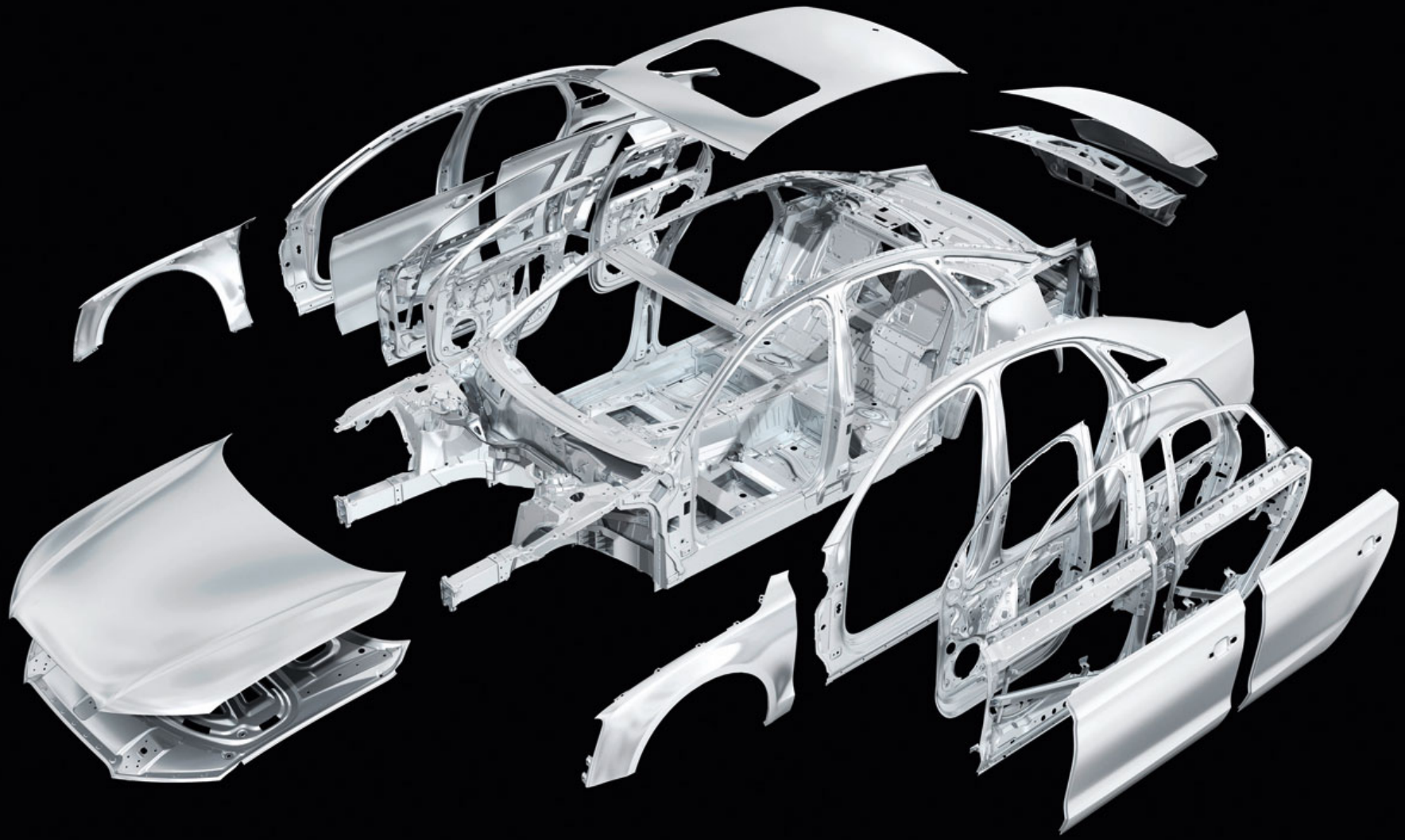
- CAFE standards flat for 25 years, despite rising fuel costs
- Average vehicle weight in 2009 EQUALS 1975
- Several factors:
  - SUVs and pickups
  - Accessories
  - Performance

Lightweighting metrics:

- Save 26M gallons of fuel, per pound off each car, over fleet lifetime
- 10% weight savings → 6-7% increase in fuel economy

US Auto industry has identified lightweighting as a primary way to meet goals . . .

Sheet metal means more than fenders and hoods . . .



2010 Audi A8

The US Automotive Industry

(this includes the materials and Tier-1 industries to various extents . . .)

- **Is highly reliant on empiricism and experience: "An Industry of Empiricism"**
  - There is "a guy" who knows how to fix various problems
  - There is "a guy" who guides trial-and-error developments
  - Design tools trained on data from existing materials, fail with new ones
  - Limited ability to capture what "the guy" knows, and if s/he leaves . . .

- **Is risk-averse regarding new materials, but wants to incorporate**
  - Knows that lightweight ***multi-material*** vehicles will be the norm

- **Uses design paradigms that do not facilitate adoption of new materials**
  - Empirically-trained models with many assumptions
  - Strain-based simulations (non-state) vs. stress-based (state)

- **Is mostly aware of what it needs to know, but needs help developing it**

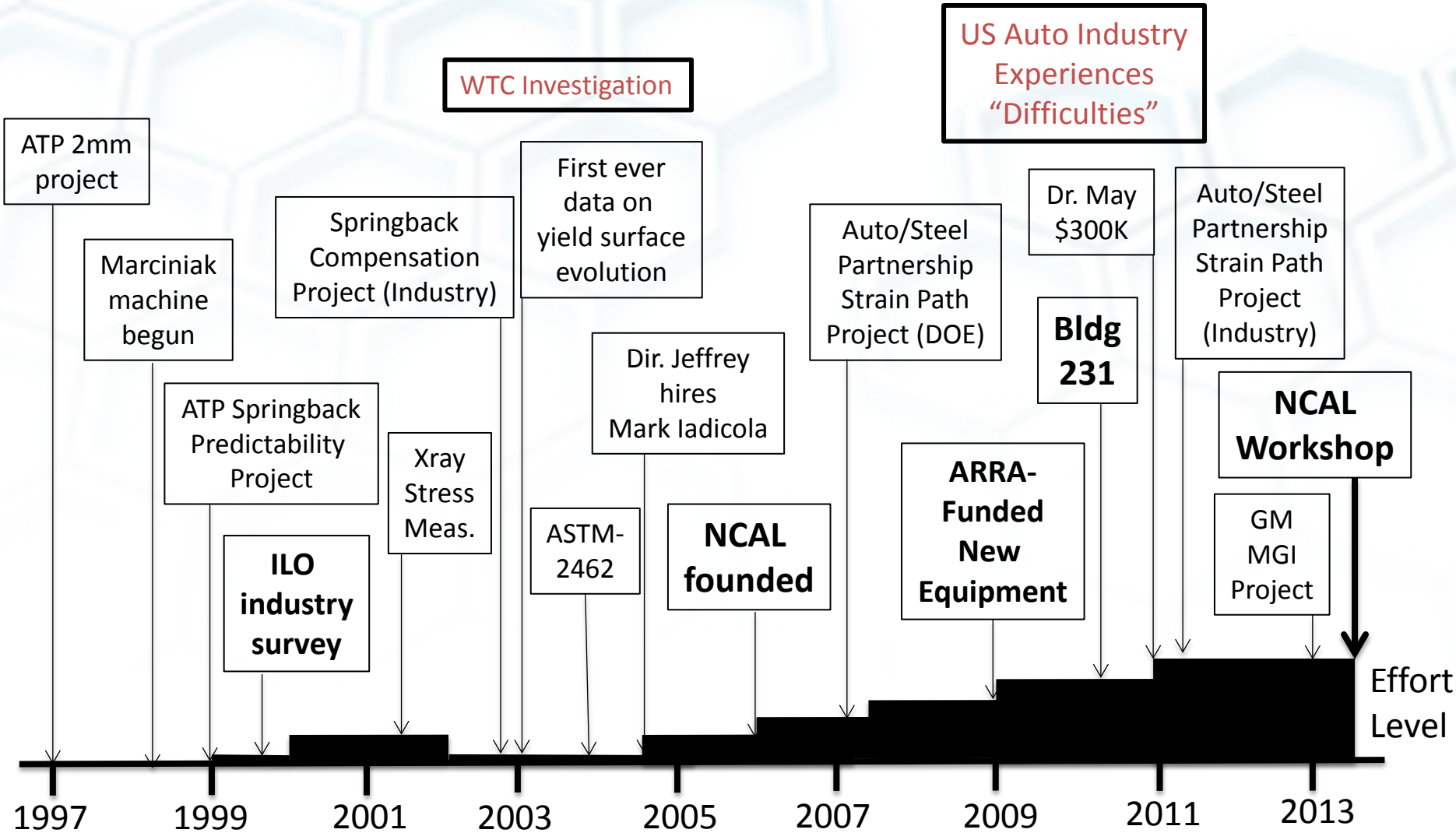
Our Boundary Conditions

- Want a “NIST-y” role
  - Measurements, Data, Standards, Helping Industry
- Broad-based Impact on the Industry
- Don’t “Pick Winners and Losers”
- Timely and Appropriate Impacts
  - They need both long-term and short-term help

NIST Center for Automotive Lightweighting

Purpose: *Developing the next-generation test methods, standards and metrology to assist the US auto industry with introducing lightweight materials into vehicles.*

NCAL Timeline



NUMISHEET Conferences

- Where the worldwide automotive industry shows their wares every 3 years
- Presentations + Benchmark Competitions (benchmarks studied for years)

- NUMISHEET 2002 (Korea)
  - Contributed talks
- NUMISHEET 2005 (Detroit)
  - Invited talk, Stress measurements for BM3
- NUMISHEET 2008 (Zurich)
  - Invited talk, Stress measurements for EBM3
- NUMISHEET 2011 (Je-Ju Island, Korea)
  - Technical Co-Chair, Invited talks
- NUMISHEET 2014 (Melbourne, Australia)
  - Technical Co-Chair, Symposium Organizer, Invited talk, Benchmark data

- We are asked to participate more all the time . . .

NCAL Workshop

May 23-24, 2013

Purposes:

- Assessment of current activities and new facilities of NCAL
- If we expand, what are the prioritized list of needs?
- Consortium discussion

Participants:

- Automotive - Ford, GM, Chrysler, Toyota, Honda
- Steel Companies – Arcelor Mittal, Nucor, USS, Severstal, Thyssen-Krupp
- Aluminum Companies – ALCOA, Novelis
- Polymer Companies – DuPont, Dow, SABIC, PPG, BASF
- Academics – NWU, CMU, Wayne State, Colo. School of Mines, UCF, Ga Tech, OSU, MSU, Mich Tech, UNH
- Other government: DOE, OSTP, ONR, Army, NSF, ORNL

Industry-Authored Report on Industry Needs Out Mid-Summer

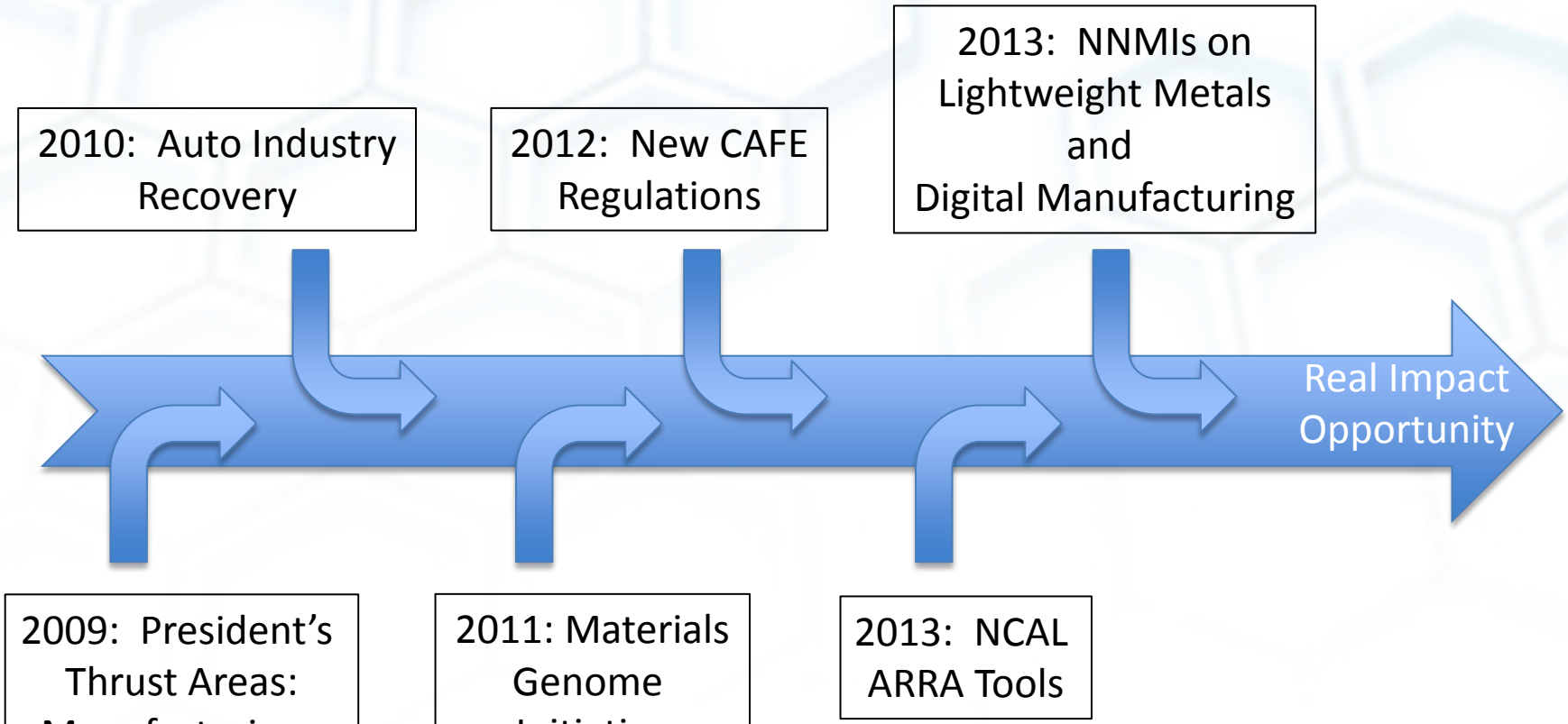
NCAL Workshop

Results: May 23-24, 2013

- NCAL staff are essential partners, national resource
- NIST is go-to organization for measurements and data
- If NCAL is expanded, the priorities are:
  - **Polymer composites** – constitutive laws, failure, high rate, fiber meas.
  - Multipath multiaxial stress-strain data – (in progress)
  - New constitutive laws – (new staff Oct. 1)
  - Digital Image Correlation (DIC) standards and best practices
  - Retained Austenite and Residual Stress measurement – (in progress)
  - Friction – (BIG nut to crack)
  - Bulge Testing, Hole Expansion, . . . (direct simulative tests)

- Lightweighting Consortium
  - "Great Idea", "The sooner the better" (GM),
    "Does it have to be a check or can it be a P.O.?" (Ford)
  - HOW?

Timely Convergence



Working With Industry – Lessons Learned

- Bring patience and fresh eyes
- Consortia + Individual Interactions
- Be clear and consistent in the NIST role
- Management support essential (impact meas.)
- Find “open space” and welcome others there

Thanks, and Questions?