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ICT/IDOT's Impact on Transportation

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ILLINOIS TRANSPORTATION AND HIGHWAY ENGINEERING CONFERENCE

We at ICT…

- Produce **groundbreaking** transportation research
- Impact **policies** and specifications
- Improve **daily lives** of traveling public and transportation of goods
- **Educate** practitioners and future engineers
- **Optimize** the limited resources of IDOT

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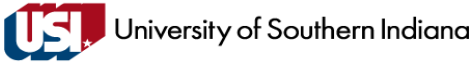
Research Project Participants

21 Universities



Research Project Participants

14 Organizations

- APTech, Inc.
- ARA, Inc.
- Champaign Co. Regional Planning Commission
- ERI, Inc.
- Heckel Engineering
- Heritage Research Group
- HierComm, Inc.
- Hutchison Engineering
- Lake Michigan Air Directors Consortium
- Murphy Pavement Technology
- SRF Consulting
- TERRA Engineering Ltd
- US Army ERDC
- USGS

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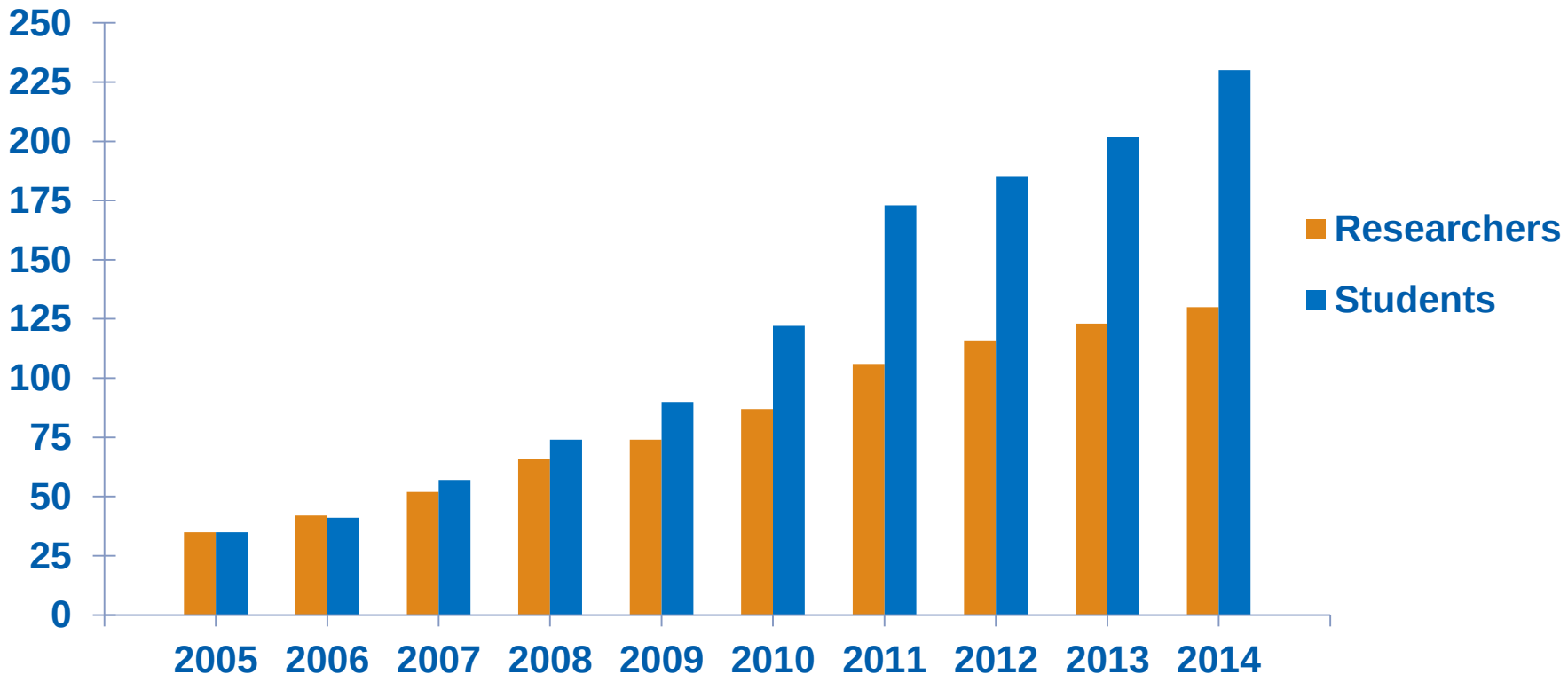
Research Project Participants

Researcher and Student Growth



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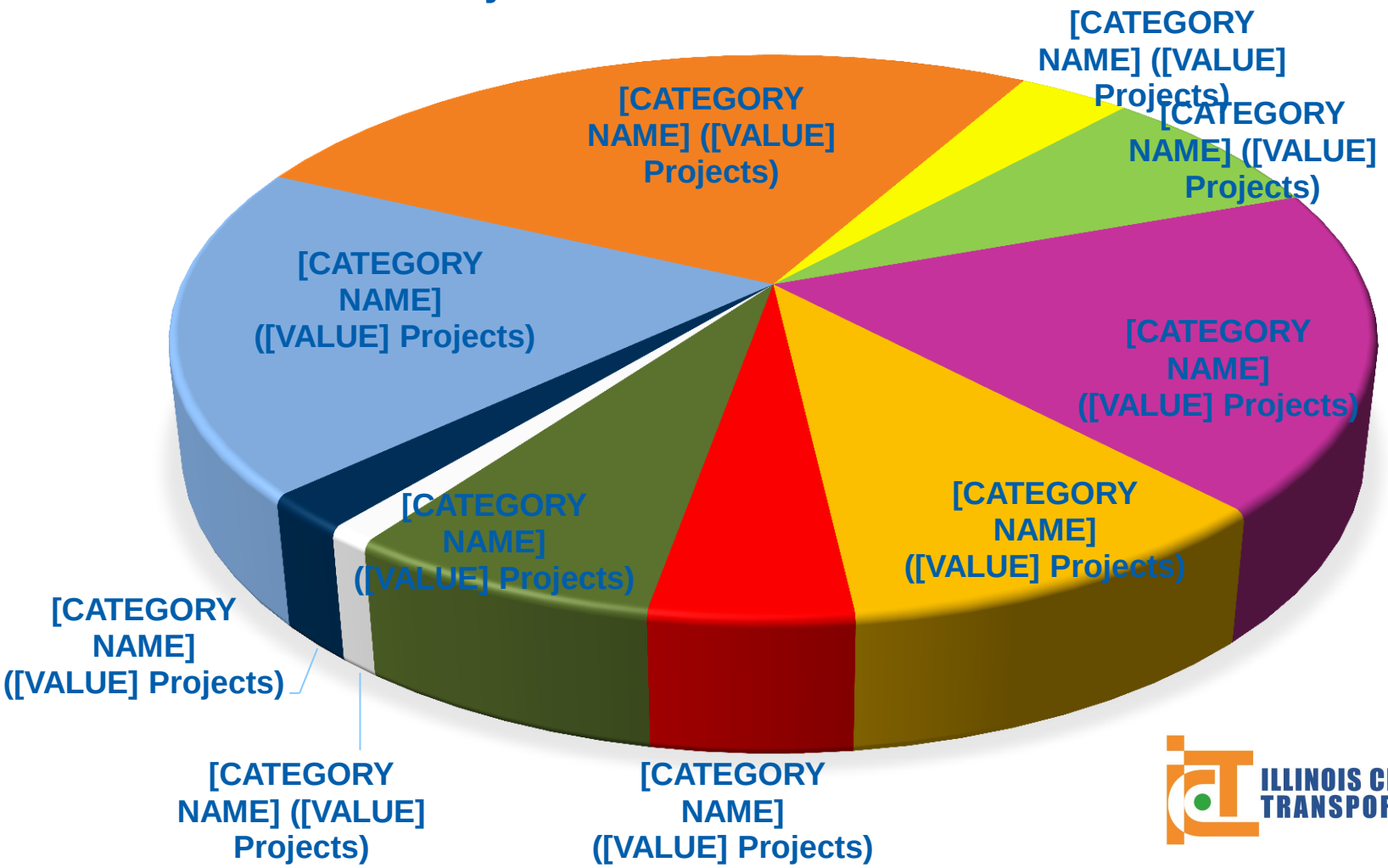
Cumulative Projects by TAG

195 Cumulative Projects



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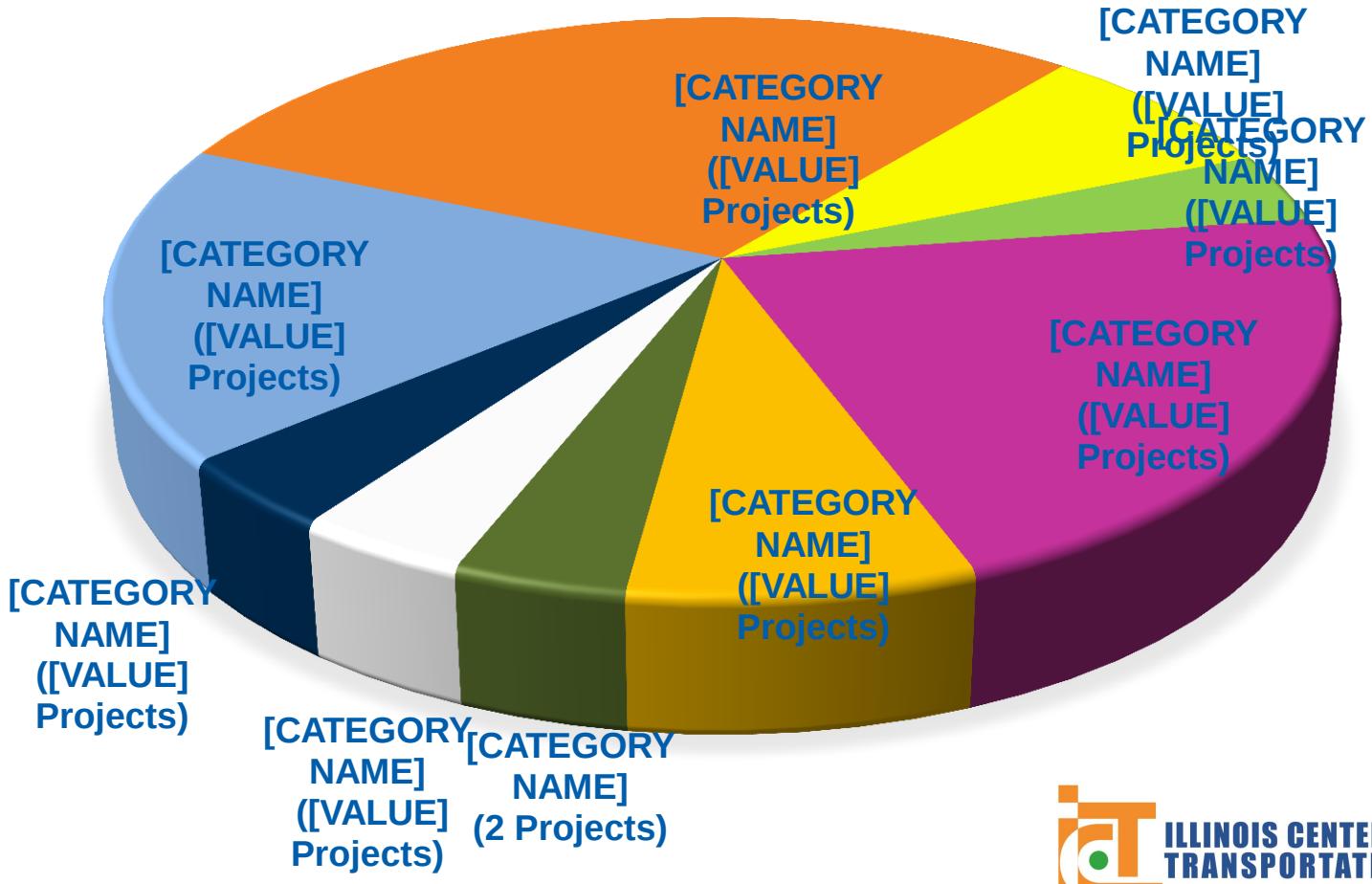
Active Projects by TAG

51 Active Projects



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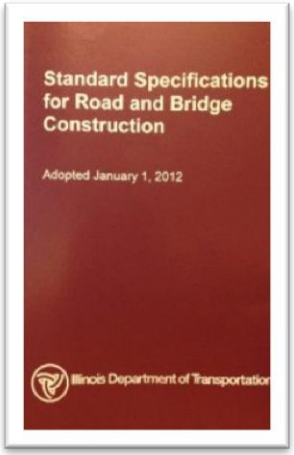
ICT Training & Conferences

- **Conferences:**
  - American Society of Civil Engineers (ASCE)
  - Transportation Research Board (TRB)
  - Bituminous Conference
  - Transportation & Highway Engineering (THE)
  - Many Others



- **Erosion Control Training**
  - ~ 400 participants in 2014
- **Documentation Training**
  - ~ 900 participants in 2015

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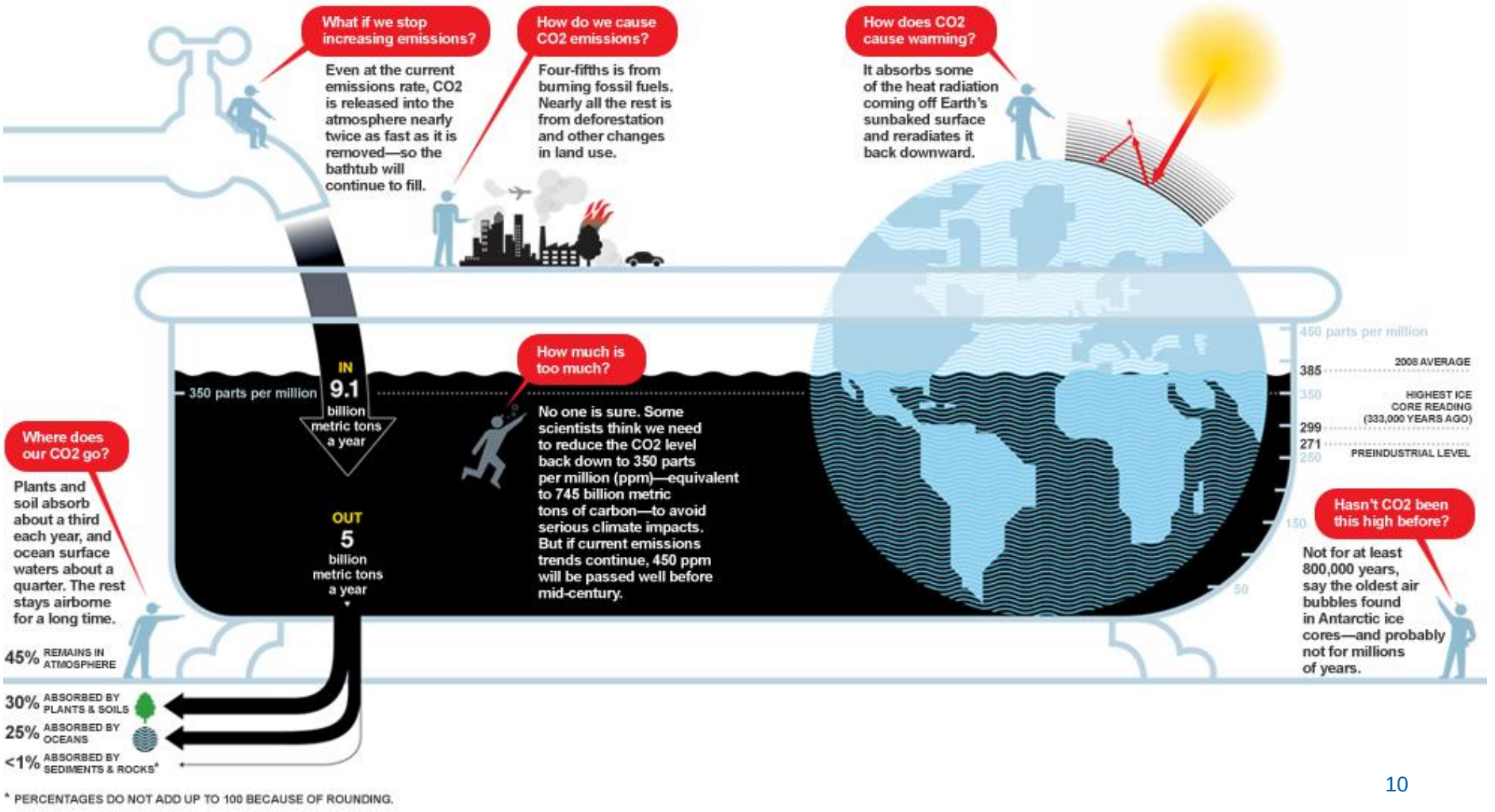
Sustainability TAG

The purpose of this TAG is to determine the research needs in various transportation areas where sustainability may be implemented or increased, including but not limited to, air or water quality, natural resources, materials, construction or maintenance methods, various modes of transportation, etc.

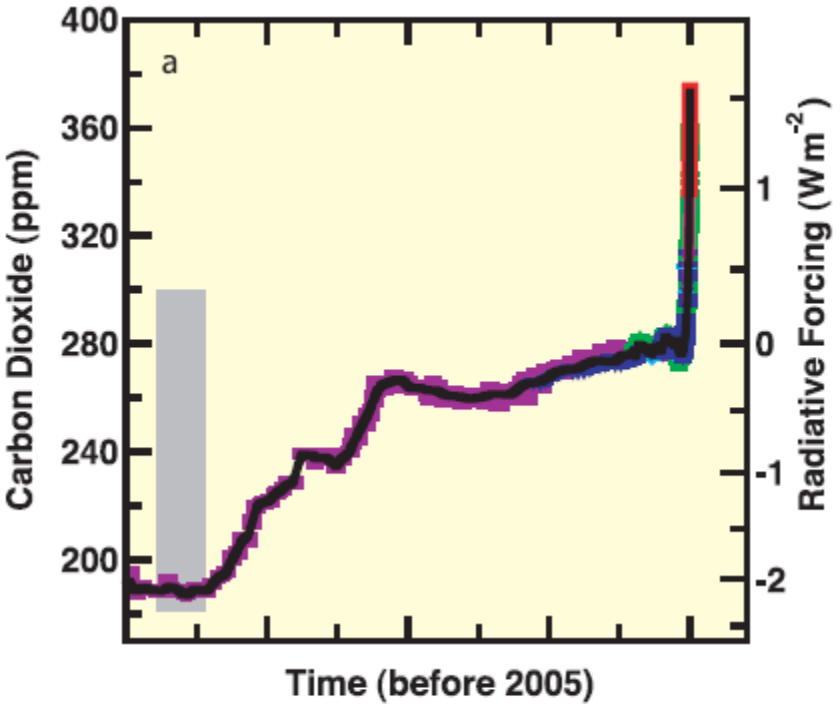
The "Carbon" Bathtub



National Geographic (Dec 2009)

Environmental Degradation and CO_2 Concentration

- Changes in atmospheric CO_2 and CH_4 far exceed pre-industrial values found in polar ice records (IPCC 2007)
- Total radiative forcing of Earth's climate increases due GHG concentration



The concentration of CO_2 has increased from a pre-industrial value of 280 ppm to 390 ppm (parts per million) (IPCC 2007)

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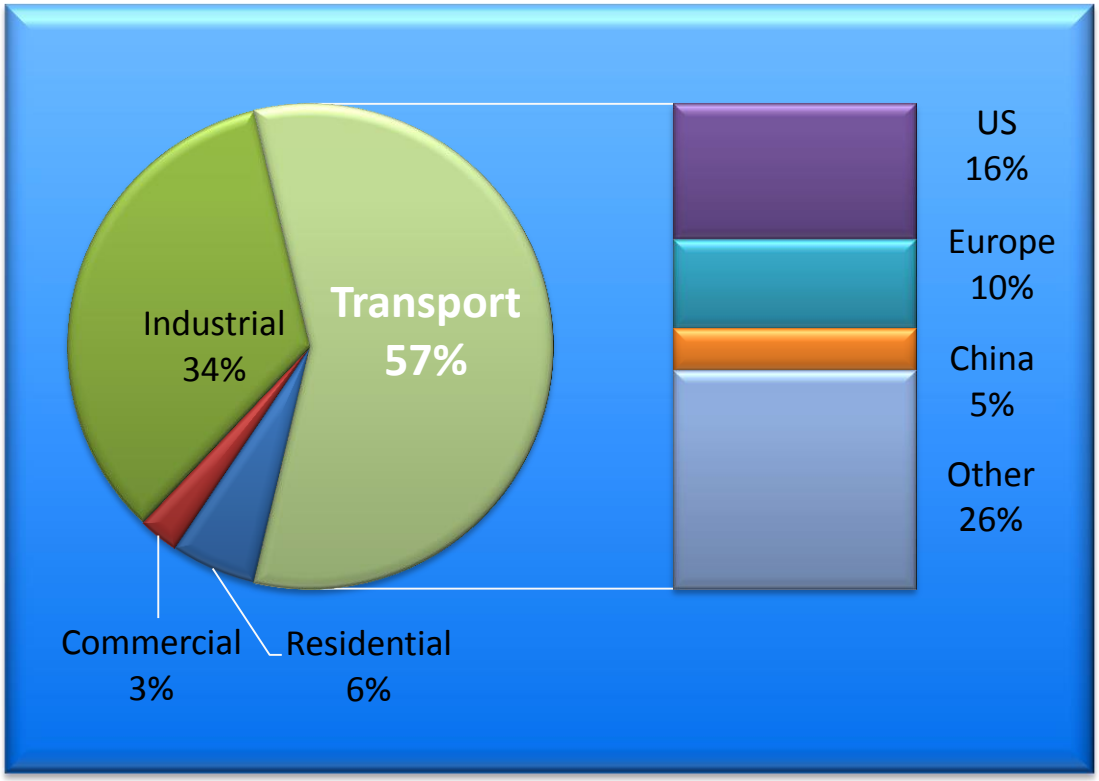
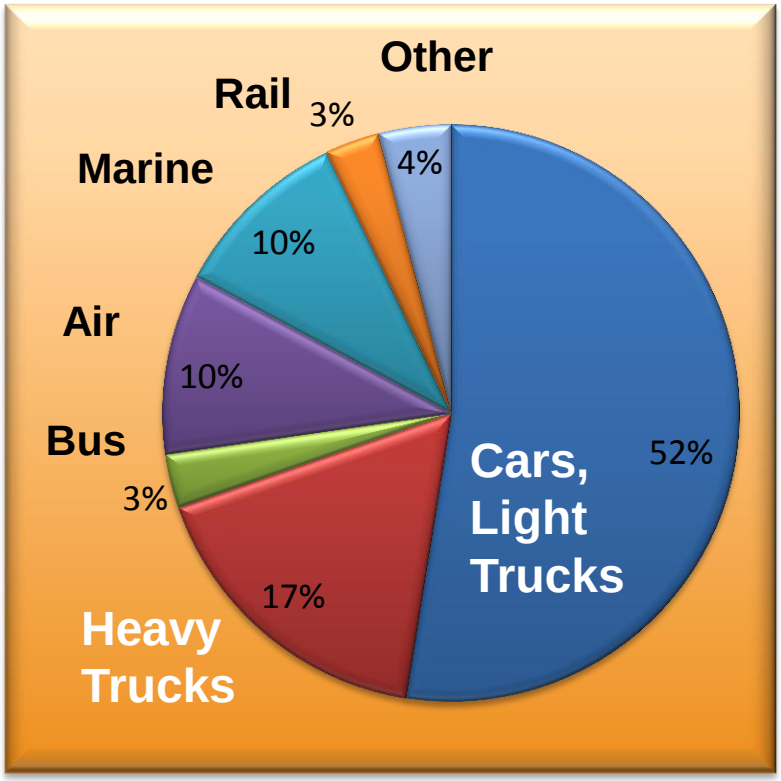
Energy and Transportation

World Petroleum Consumption by End-Use Sector



World Transportation Energy by Mode



International Energy Outlook (2013)
World Energy Council Global Transport Scenarios 2050 (2011)

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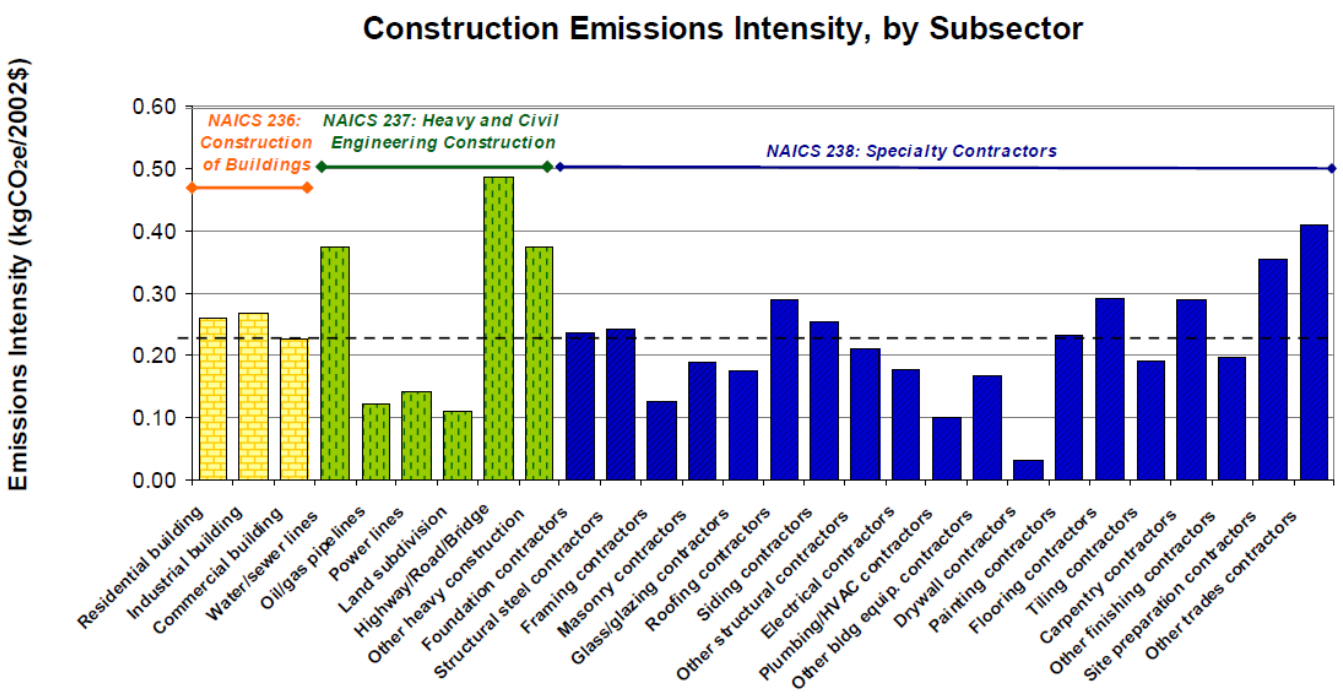
Highway Construction (EPA 2009)

- Emission intensity: 0.49 m-ton CO_2-eq/$1000GDP (2002)

Figure 4: Construction Industry Emissions Intensity, with Breakdown by Subsector, in $MTCO_2e/2002k$



Note: A table of emissions and value added for each subsector is available in Appendix B, and descriptions of NAICS codes for construction subsectors are located in Appendix C.

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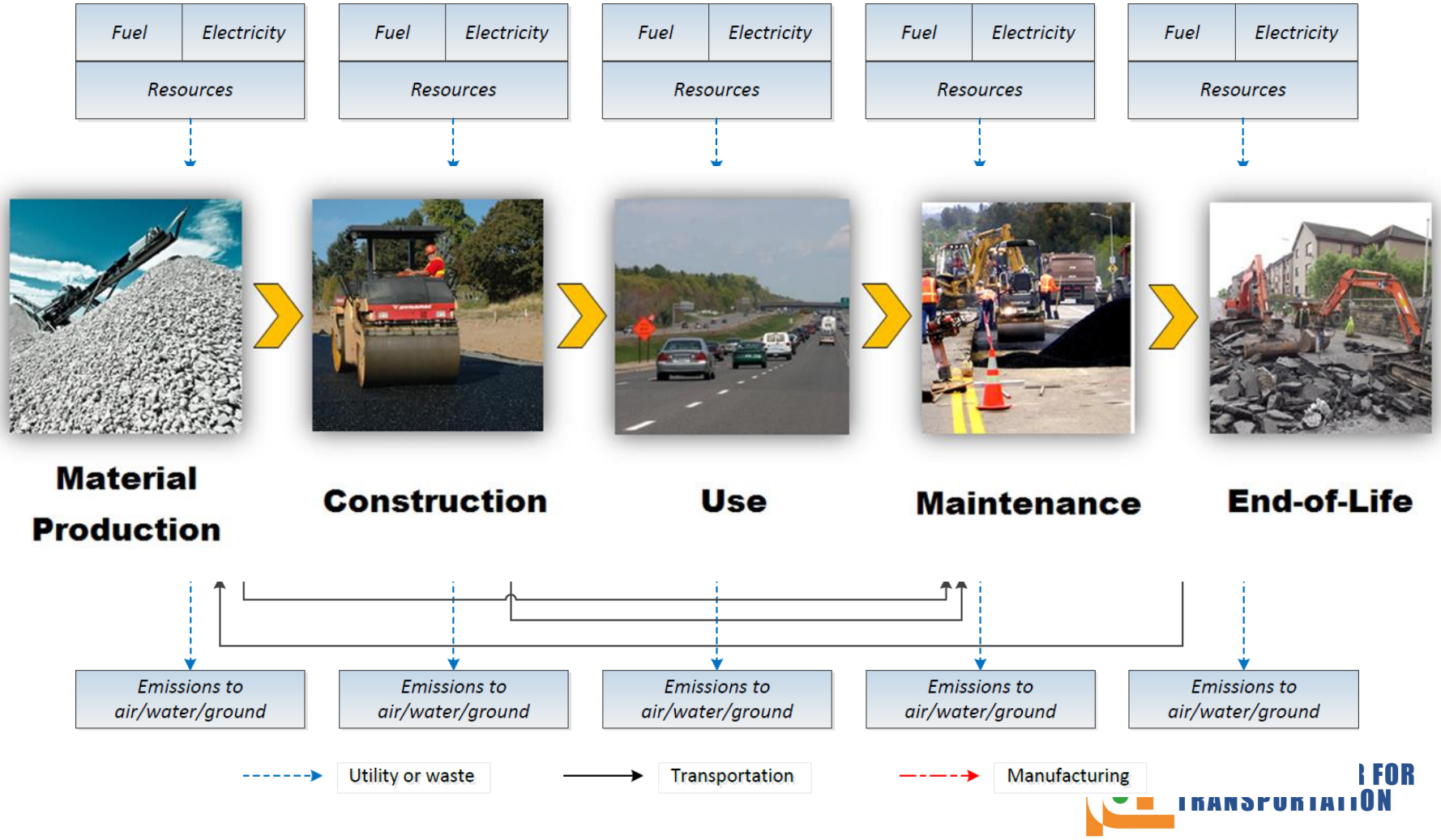
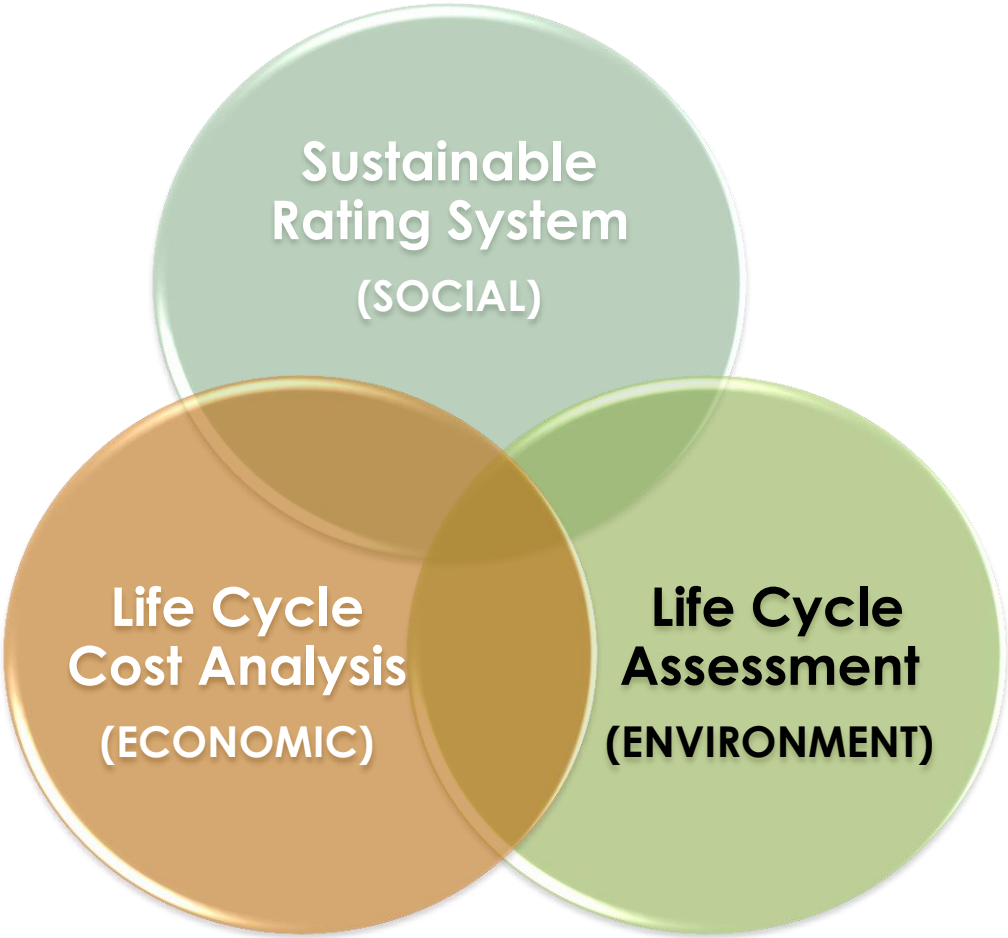
LCA Phases

Cradle to grave interactions of environment & product system



Why LCA?

- **Quantify** environmental impacts
- **Evaluate** improvements in sustainability goals
- **Determine** where investment can be most effective



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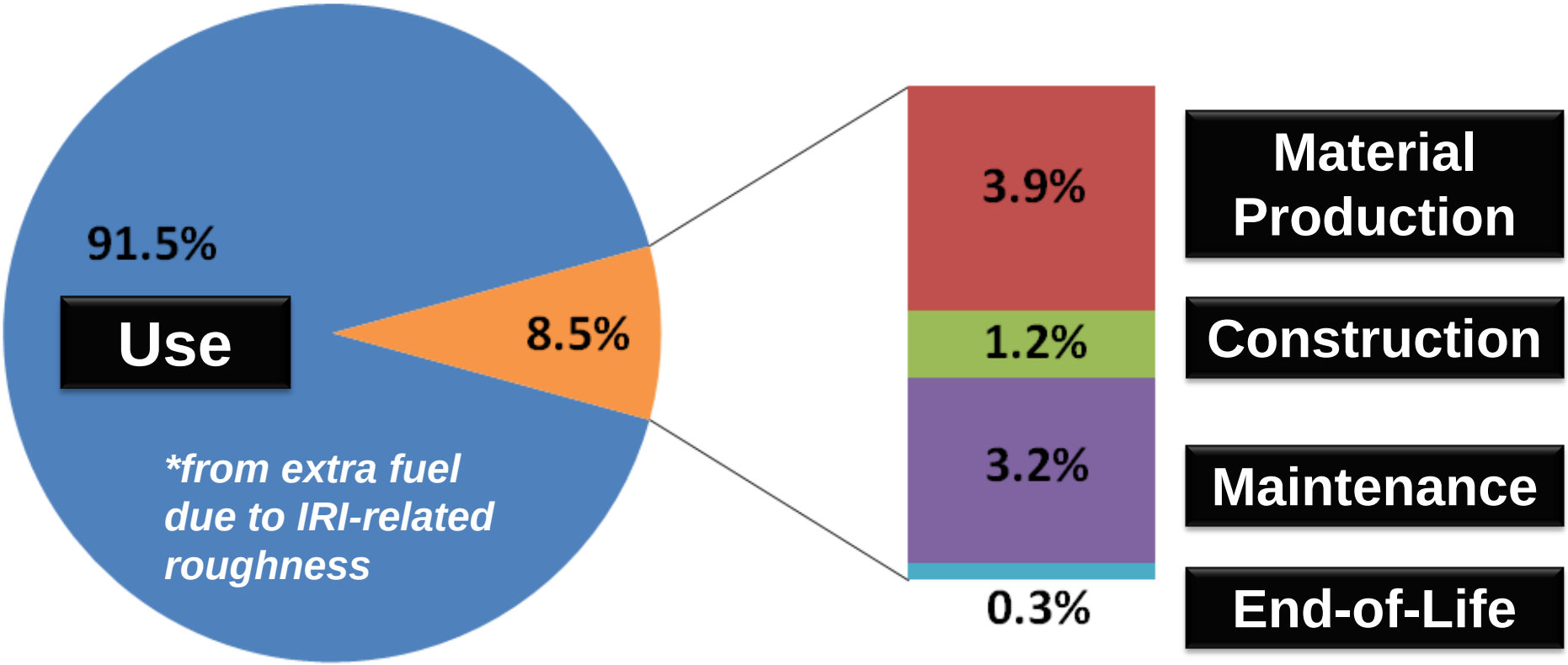
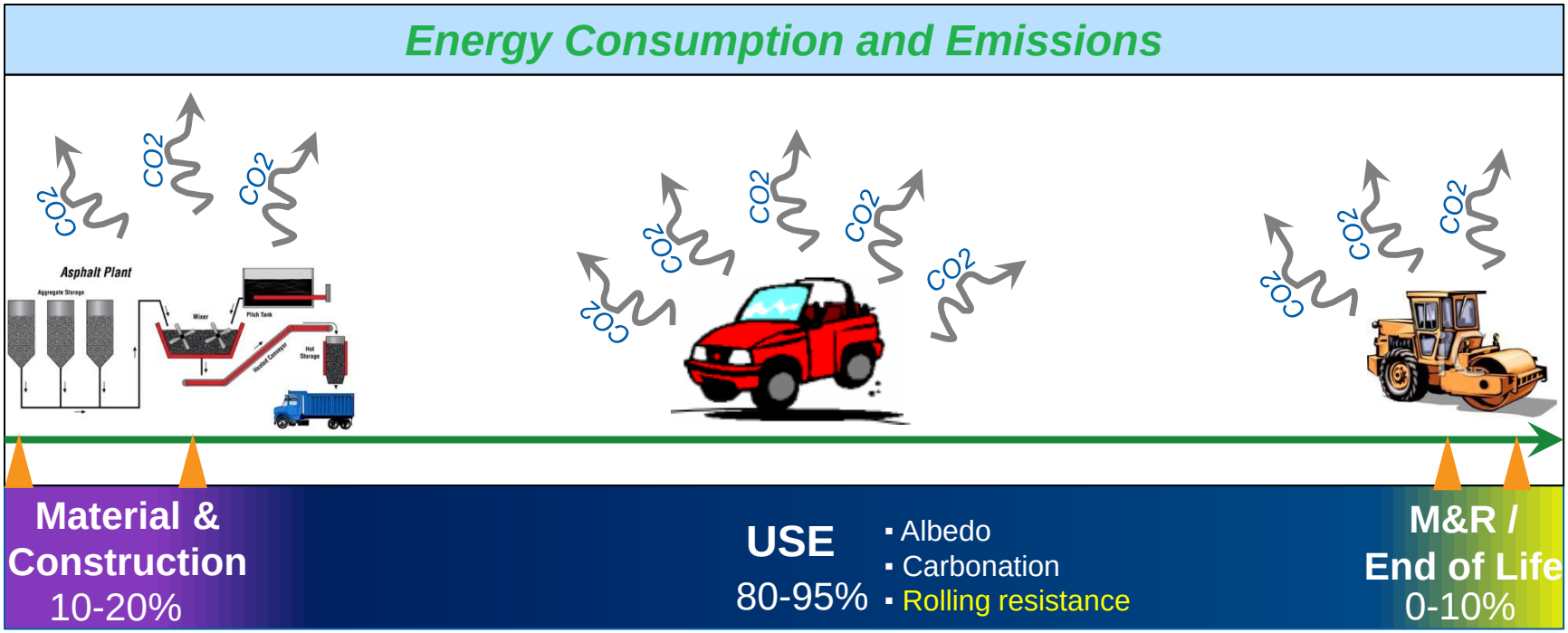
Life-cycle "Thinking" for Pavements

Energy Consumed in an Asphalt Pavement Life Cycle



Use-Phase in Pavement LCA



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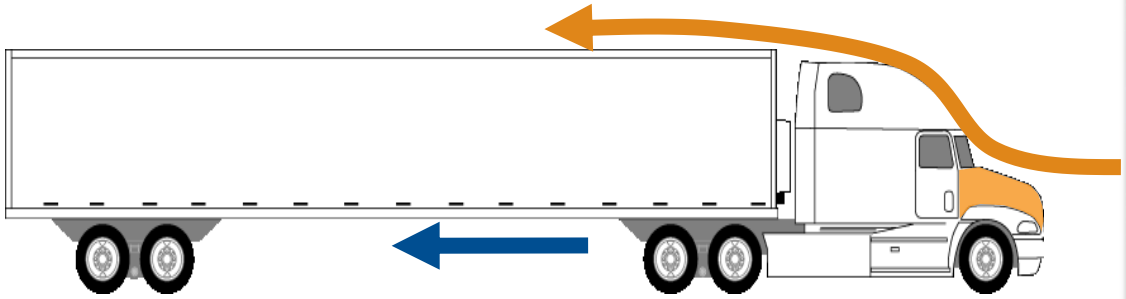
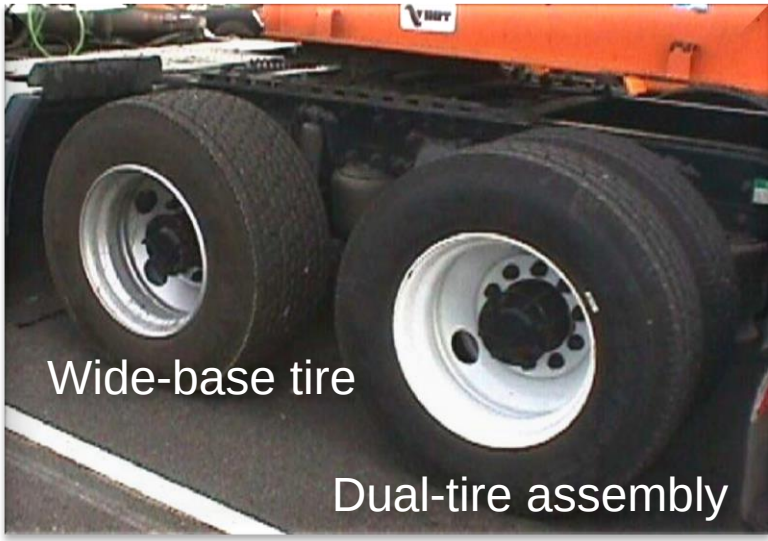
Tire Rolling Resistance!

aerodynamic drag — **At 60 mph (100 km/h), aerodynamic drag consumes approximately 40% of the fuel**

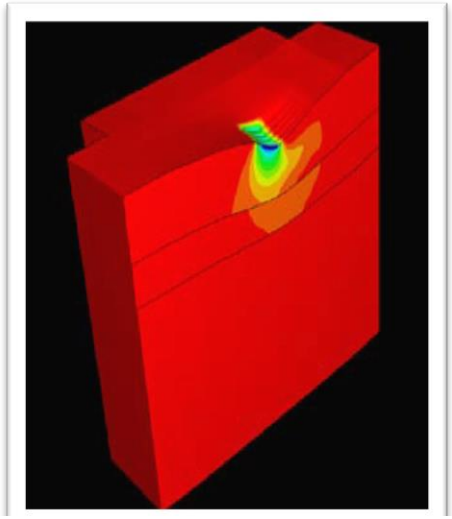
mechanical losses — **Mechanical losses consume approximately 25% of the fuel**

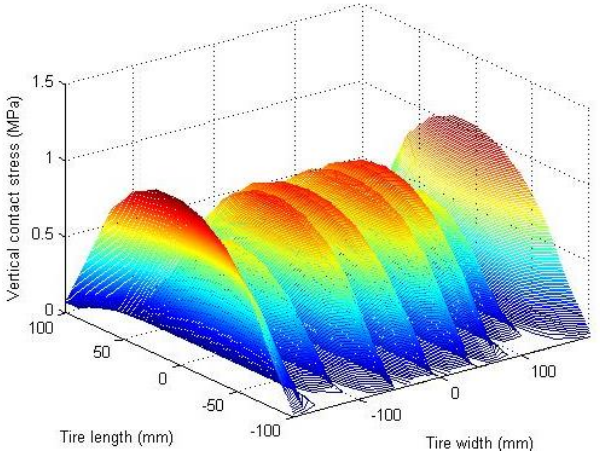
rolling resistance — **Rolling resistance accounts for approximately 35% of the fuel consumed**

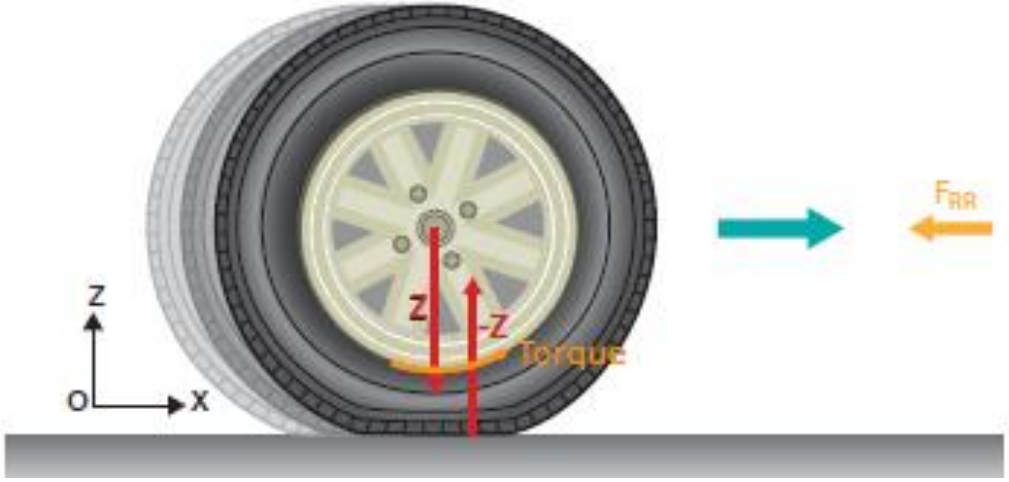


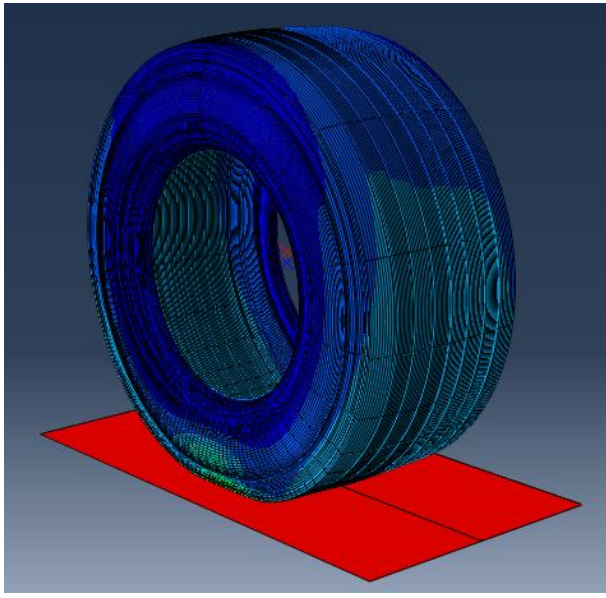


Tire Rolling Resistance Models

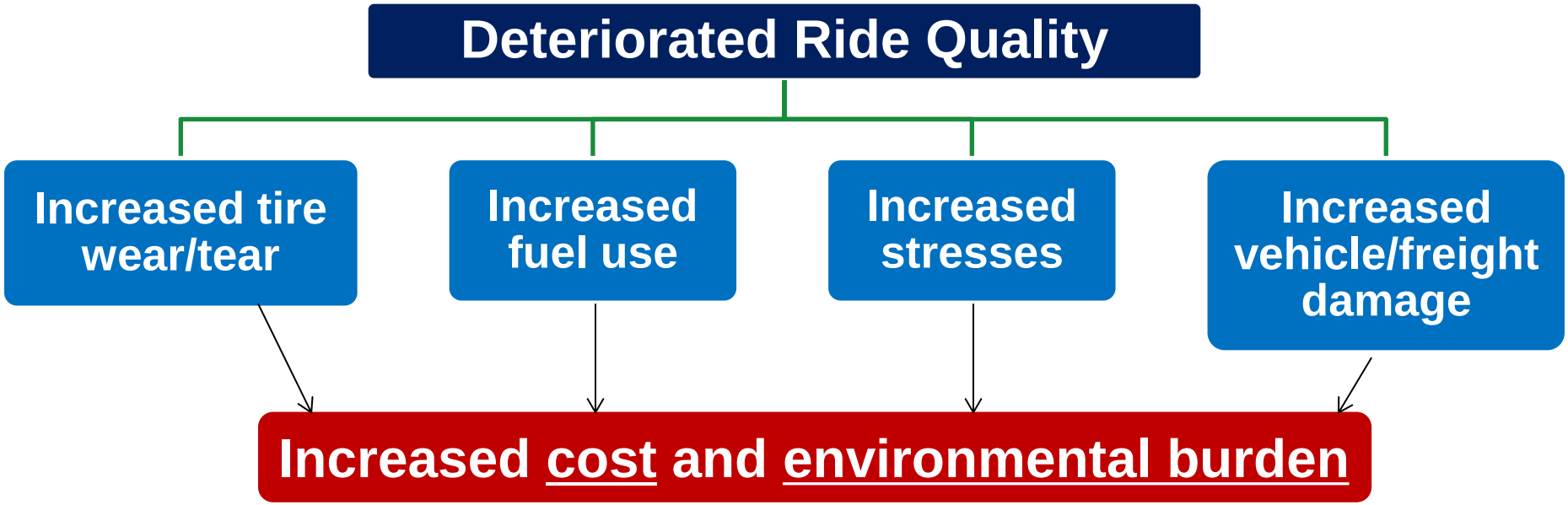








Tire-Vehicle-Pavement Interaction



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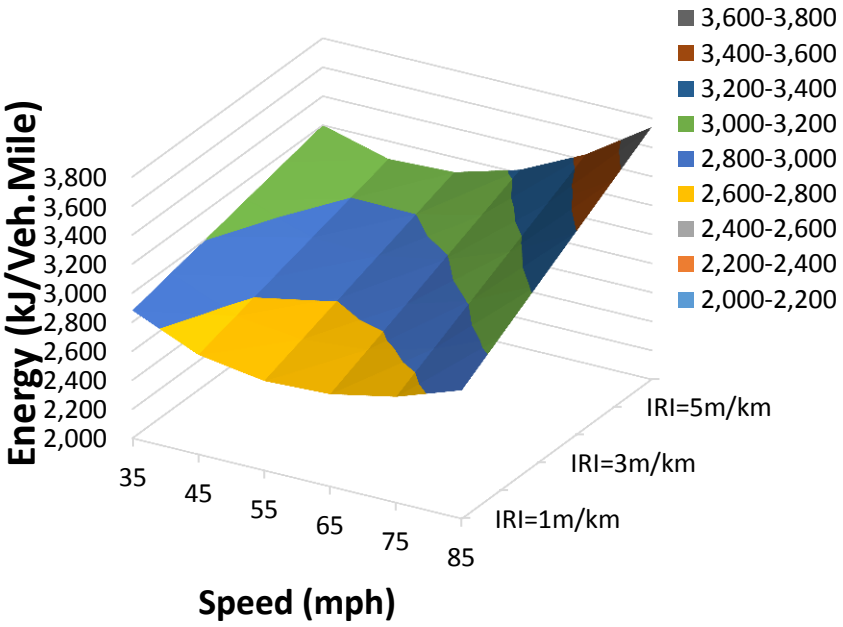
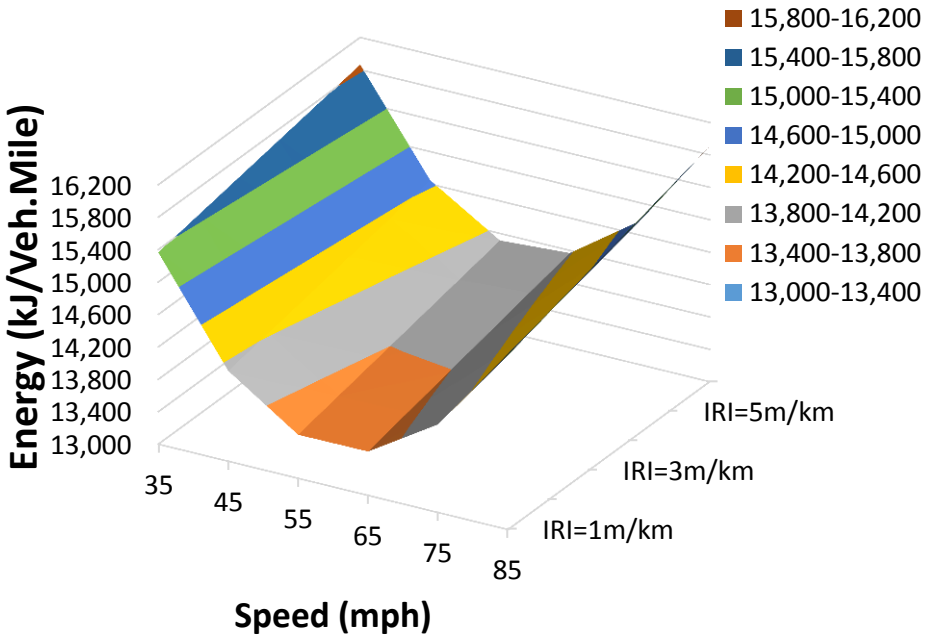
Some Results

- Sensitivity of **Energy** consumption to Speed and IRI



Passenger Car



Large Truck

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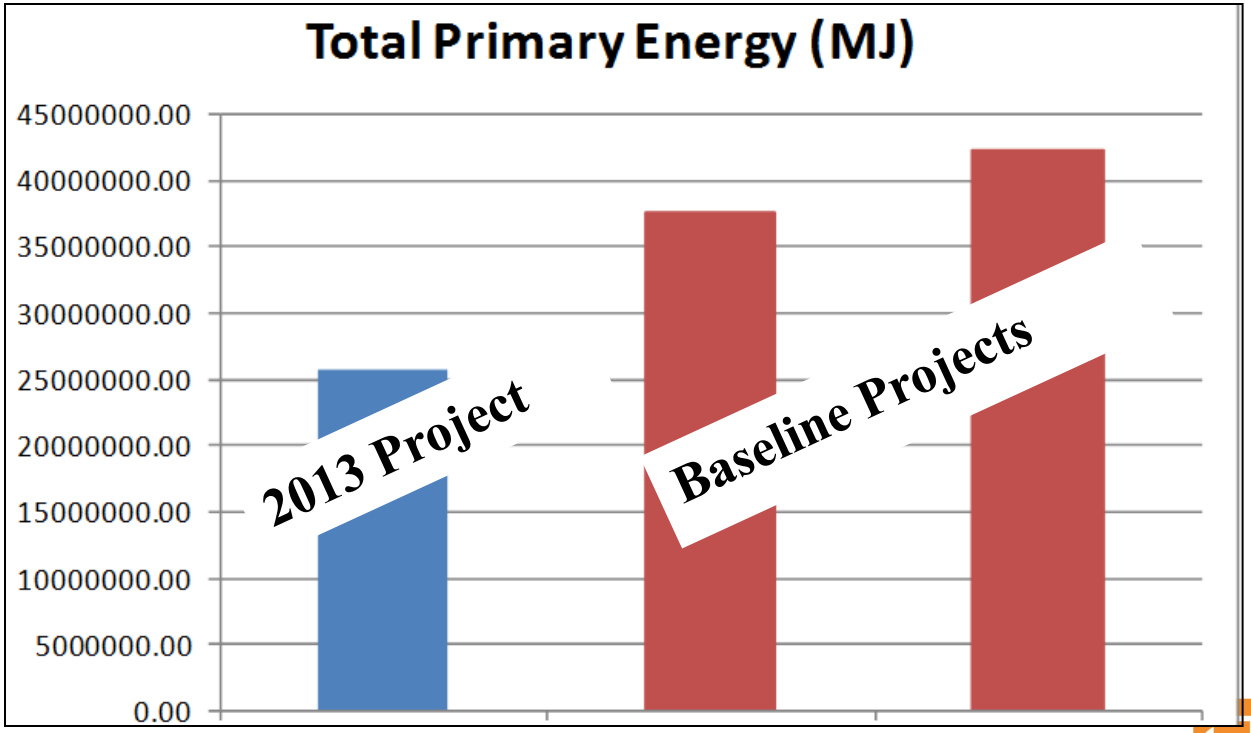
Case Study 1: Project Baselines

- To evaluate the **improvement** in sustainable pavement projects for the **Illinois Tollway**
- Includes **material and construction phases** only



Performed by ARA, Inc.

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Case Study: Flexible Pavement Results

28% GWP savings

35% Energy savings

Equivalent to 2336 barrels of oil per lane-mile!

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Case Study 2: Complete Life Cycle

- **2008 reconstruction project for Illinois Tollway**

• 5 miles • Full depth asphalt pavement • Outer, inner shoulders	• 60 year analysis period • 66,000 ADT • 1.97% traffic growth • 11.3% trucks

- **Used actual mixes and predicted maintenance schedule**
- **For use phase, extrapolated IRI progression from historical data for extra fuel consumption due to rolling resistance**

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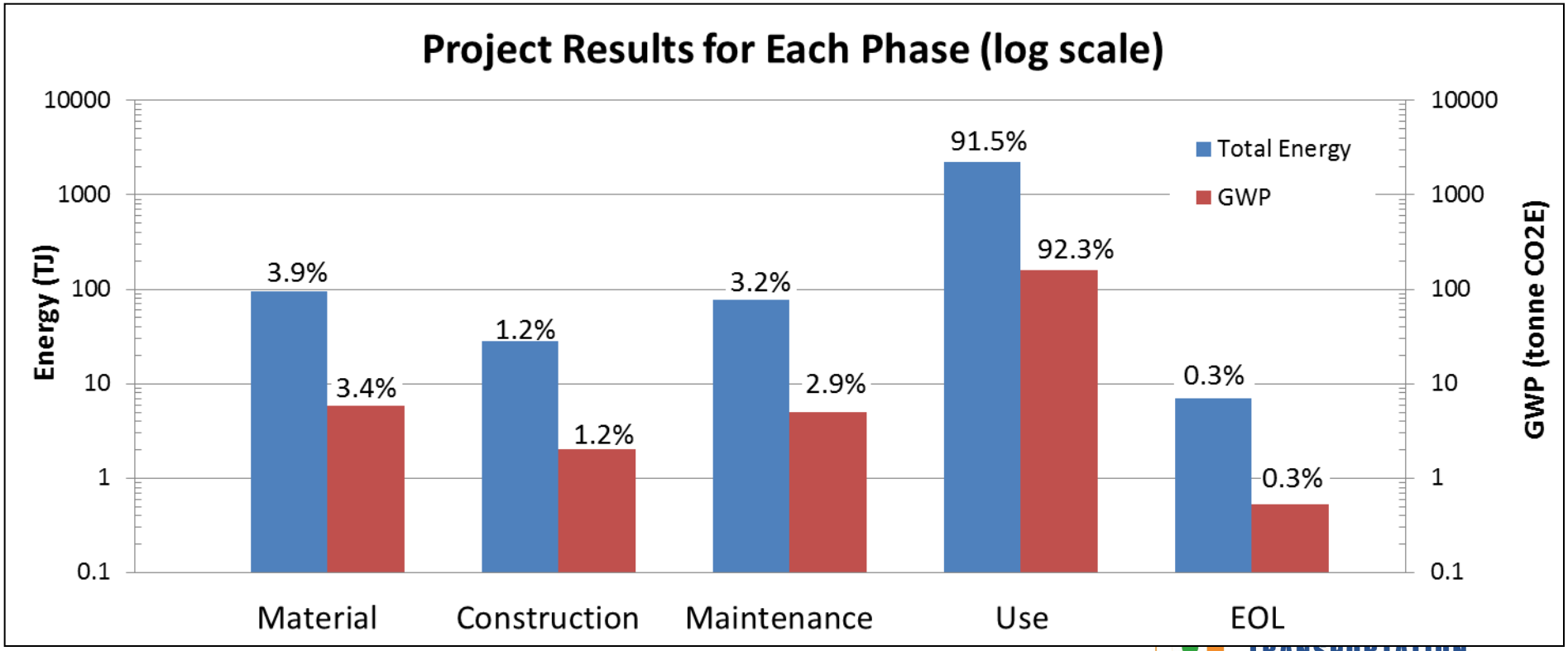
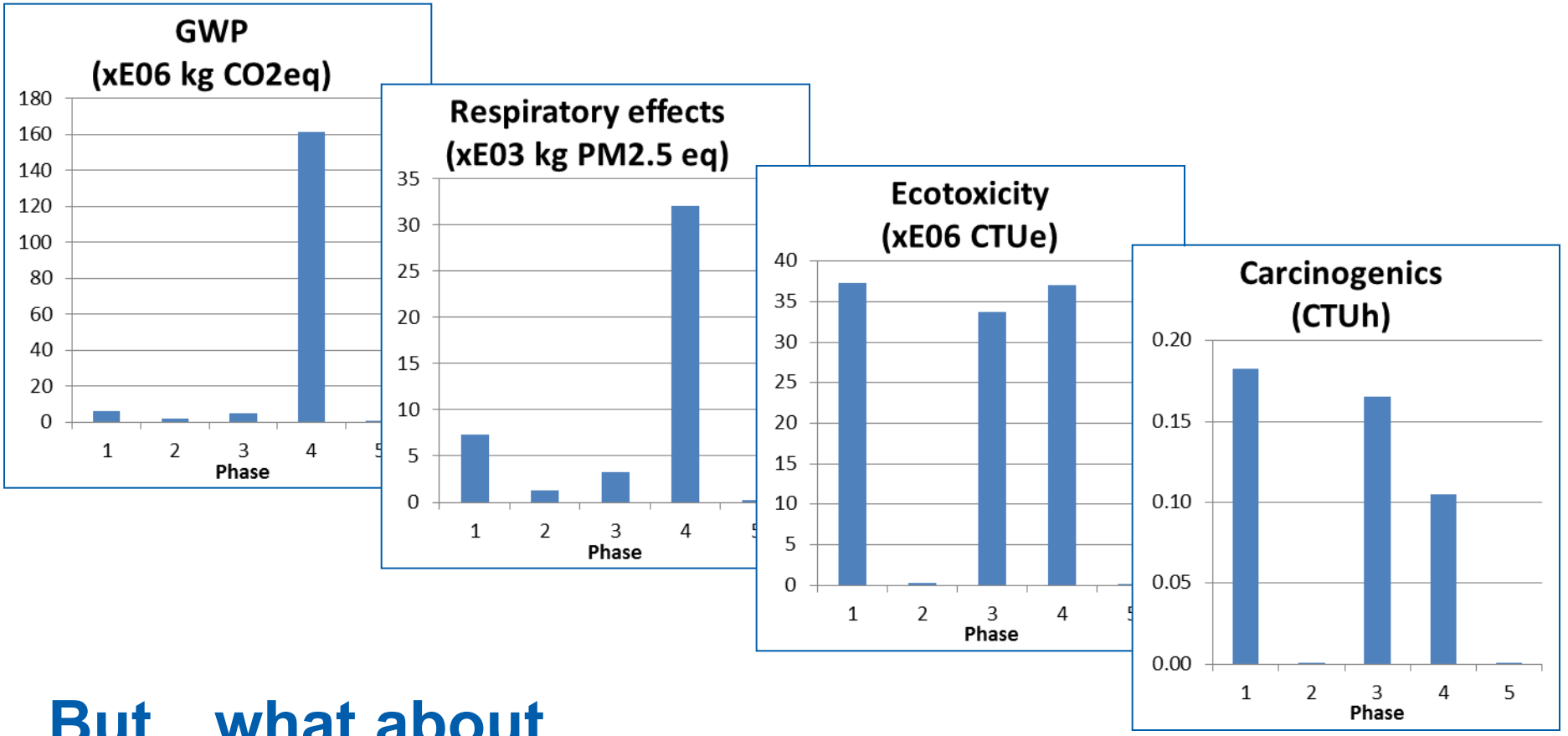
CS2: Results

- Overwhelming majority energy consumption and GWP are from the use phase



CS2: More Results



But…what about

other impact categories?

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