

# **GREAT DESIGNS IN STEEL**

**Presentations will be available for  
download on SMDI's website on  
Wednesday, May 22**

# GREAT DESIGNS IN **STEEL**

## **LIFE CYCLE GHG CONSEQUENCES OF LIGHTWEIGHTING WITH ALUMINUM OVER AHSS**

Brandie M. Sebastian  
Director, Sustainability  
American Iron and Steel Institute

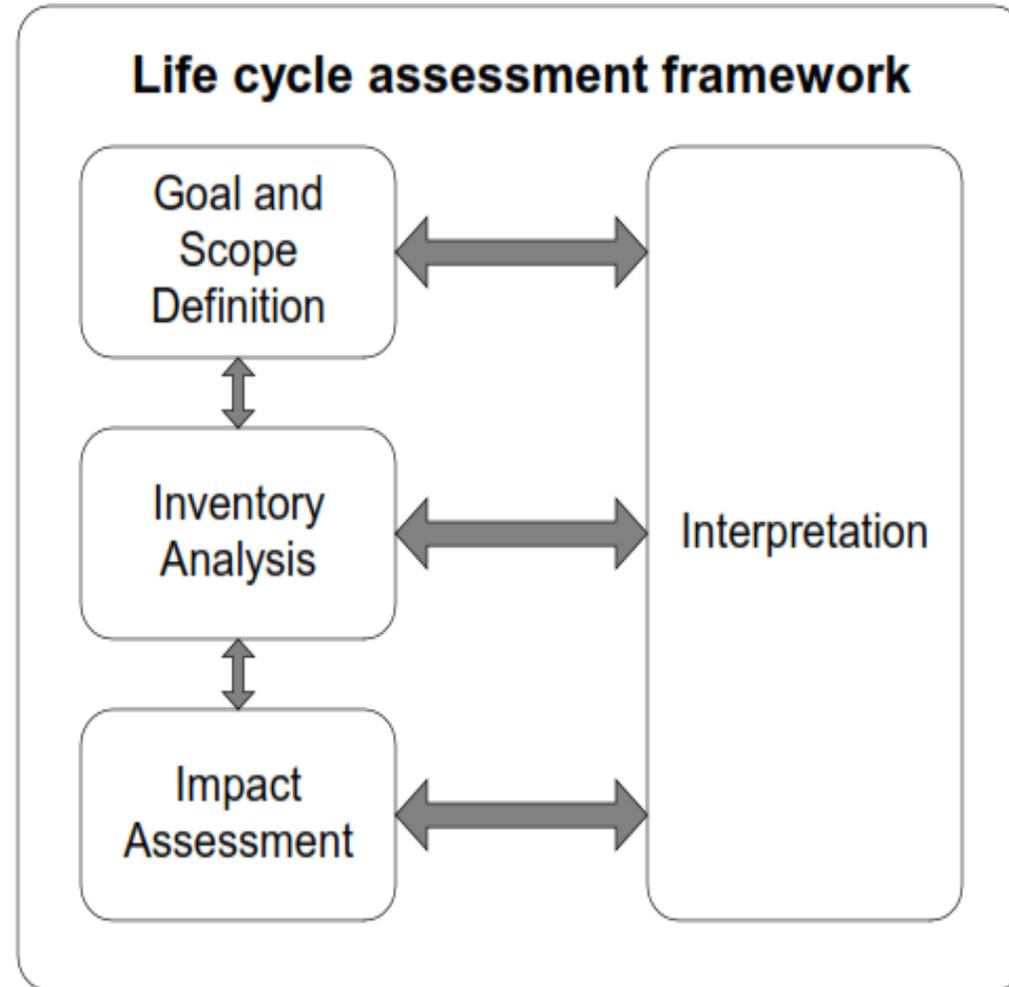
# AISI SUSTAINABILITY

- Life cycle inventory (LCI) data collection and distribution
- LCA studies, including steel vs. competing materials
- Steelmaking footprint reduction and regional benchmarking
- LCA methodology research and standards development
- Promoting recycling of all steel products

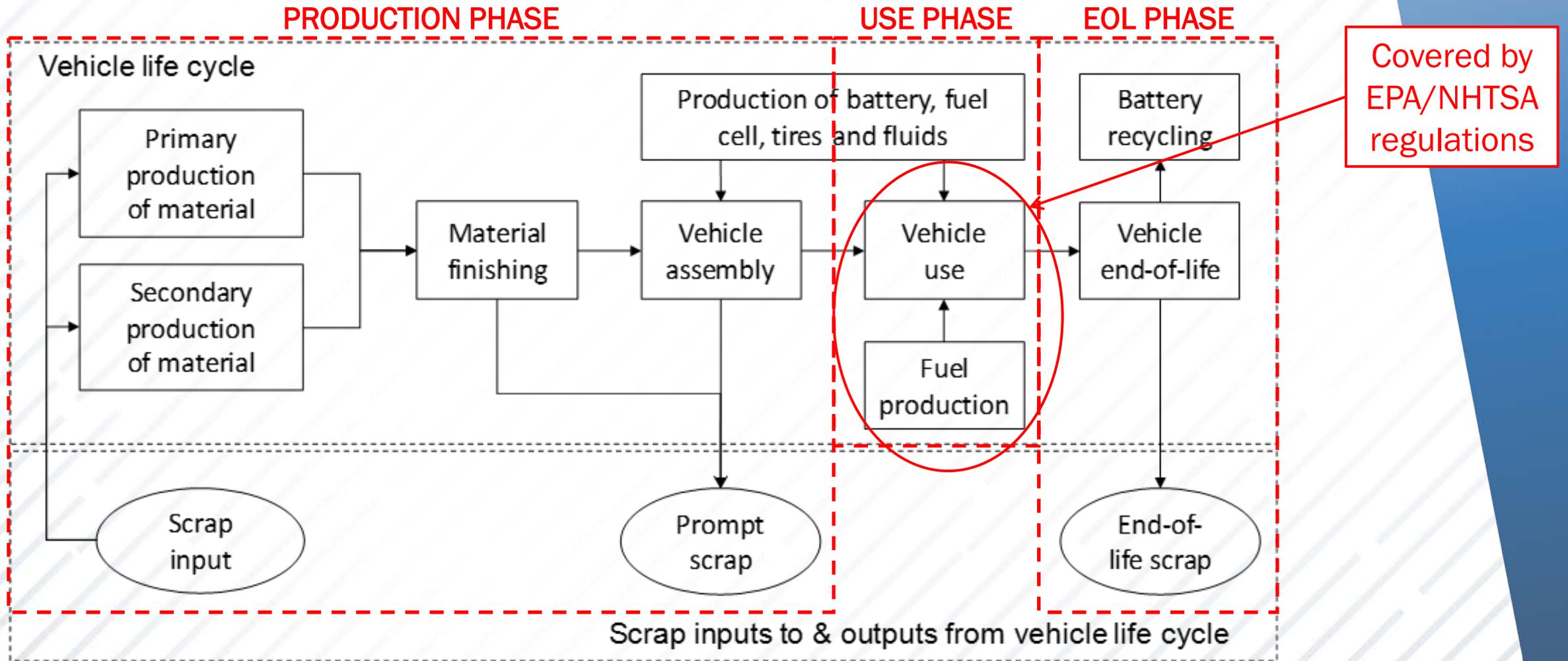


# LIFE CYCLE ASSESSMENT

- Standardized and comprehensive method
- Evaluates potential environmental and human health impacts
- Applicable to a product, material, process, or service throughout its life cycle

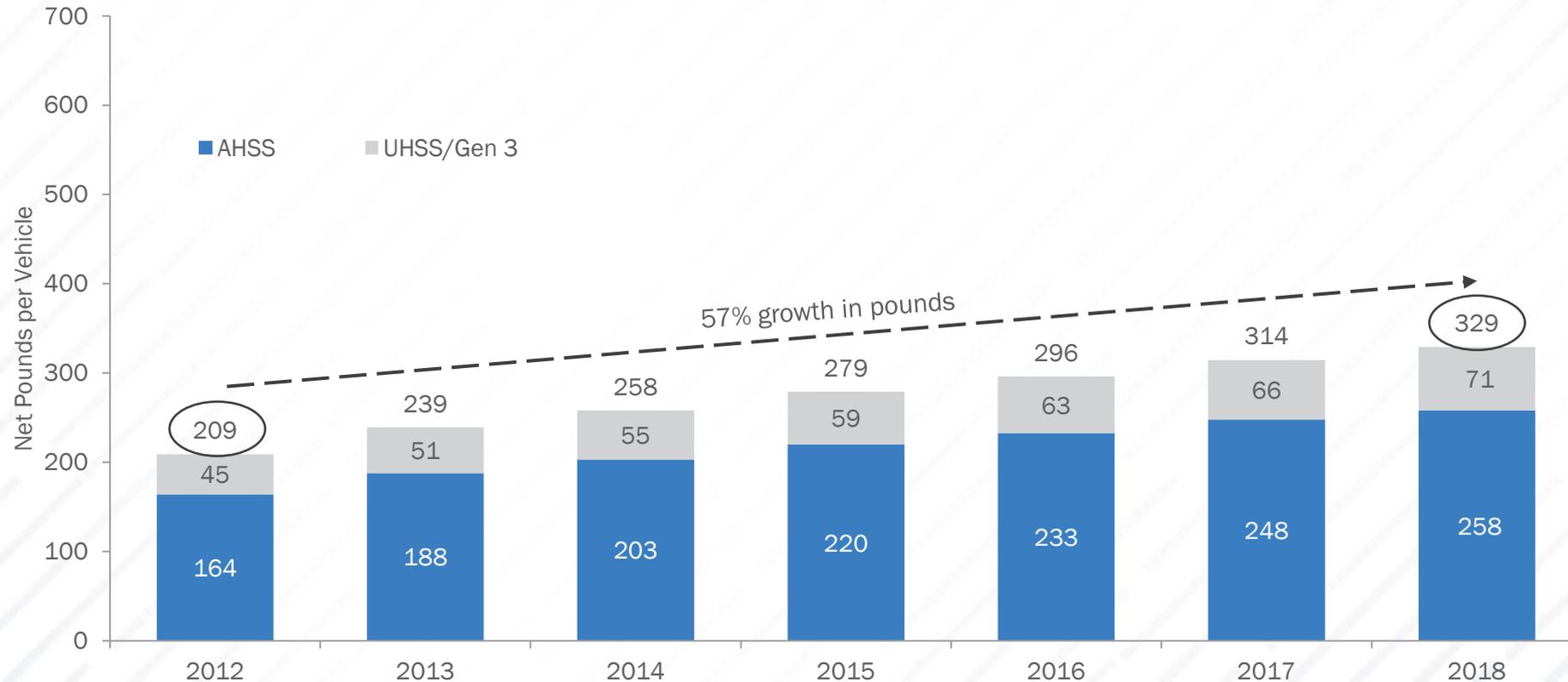


# VEHICLE LIFE CYCLE & FUEL ECONOMY REGULATIONS



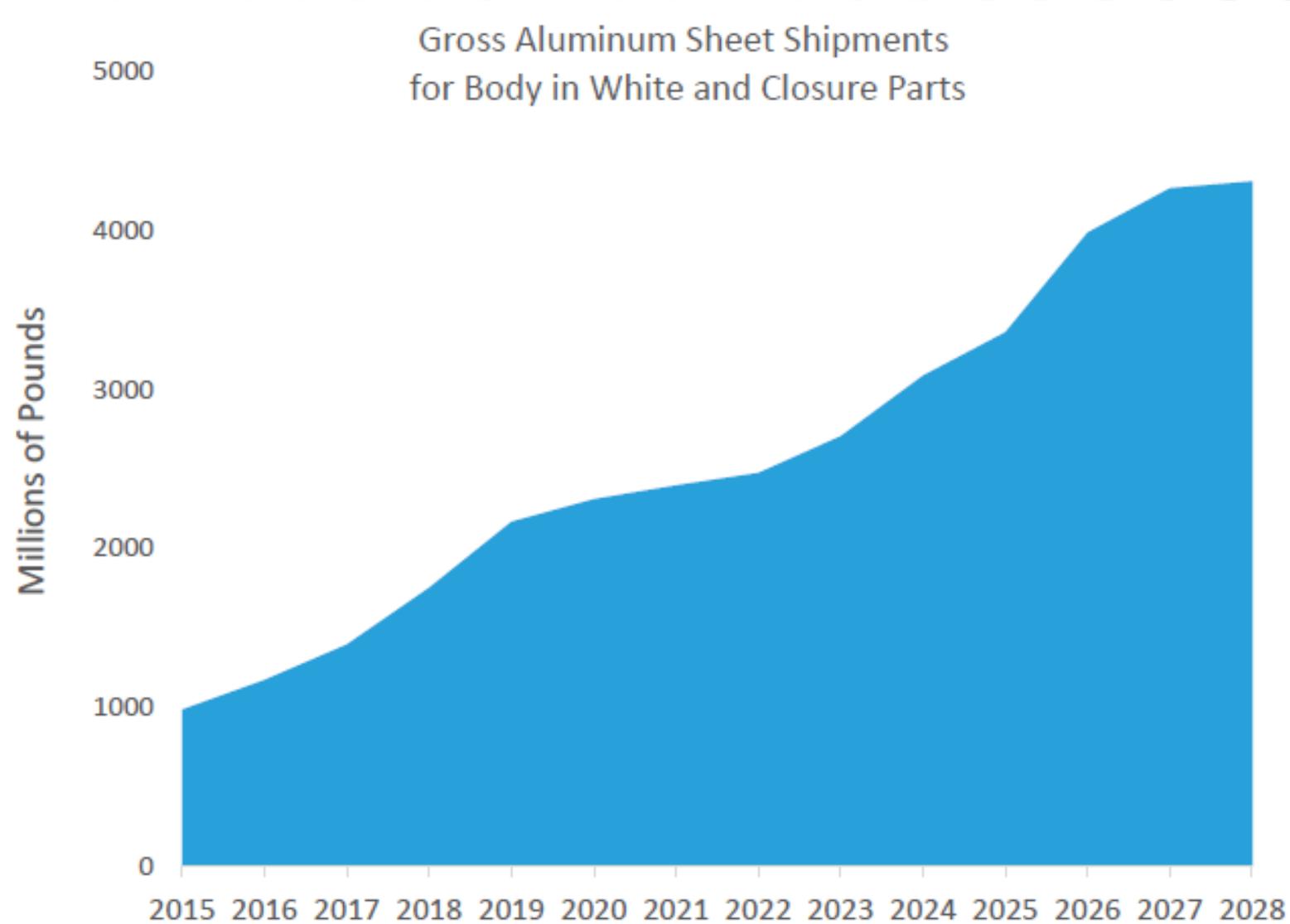
# VEHICLE LIGHTWEIGHTING IN NORTH AMERICA

NA Light Vehicle AHSS and UHSS Utilization Forecast



Excludes ~2% used for service / crash parts  
Numbers may be +/- 1-2% due to rounding error and estimation

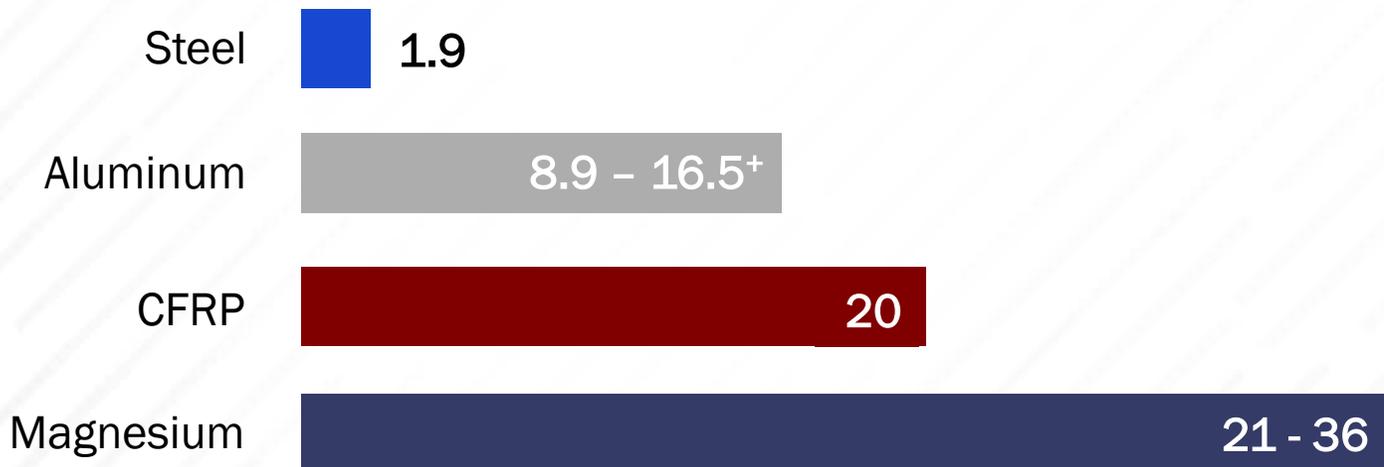
# VEHICLE LIGHTWEIGHTING IN NORTH AMERICA



Source: Ducker Worldwide, Aluminum Content in North American Light Vehicles 2016 to 2028, Summary Report, July 2017.

# PRODUCTION EMISSIONS FOR AUTOMOTIVE MATERIALS

Cradle-to-Gate GHG Emissions from Primary Production  
(in kg CO<sub>2</sub>e/kg of material)



Notes:

- Steel, aluminum, and magnesium values do not include finishing emissions.
- Carbon fiber reinforced plastic (CFRP) automotive parts are formed via an integrated process, which includes both production and finishing.

Sources: World Steel Association, 2010. Aluminum Association, 2013 and International Aluminum Association, 2013 (aluminum range represents North American to global average production). GaBi professional database as included in the UCSB Model v5, 2017.

# EMISSIONS TRADE-OFFS

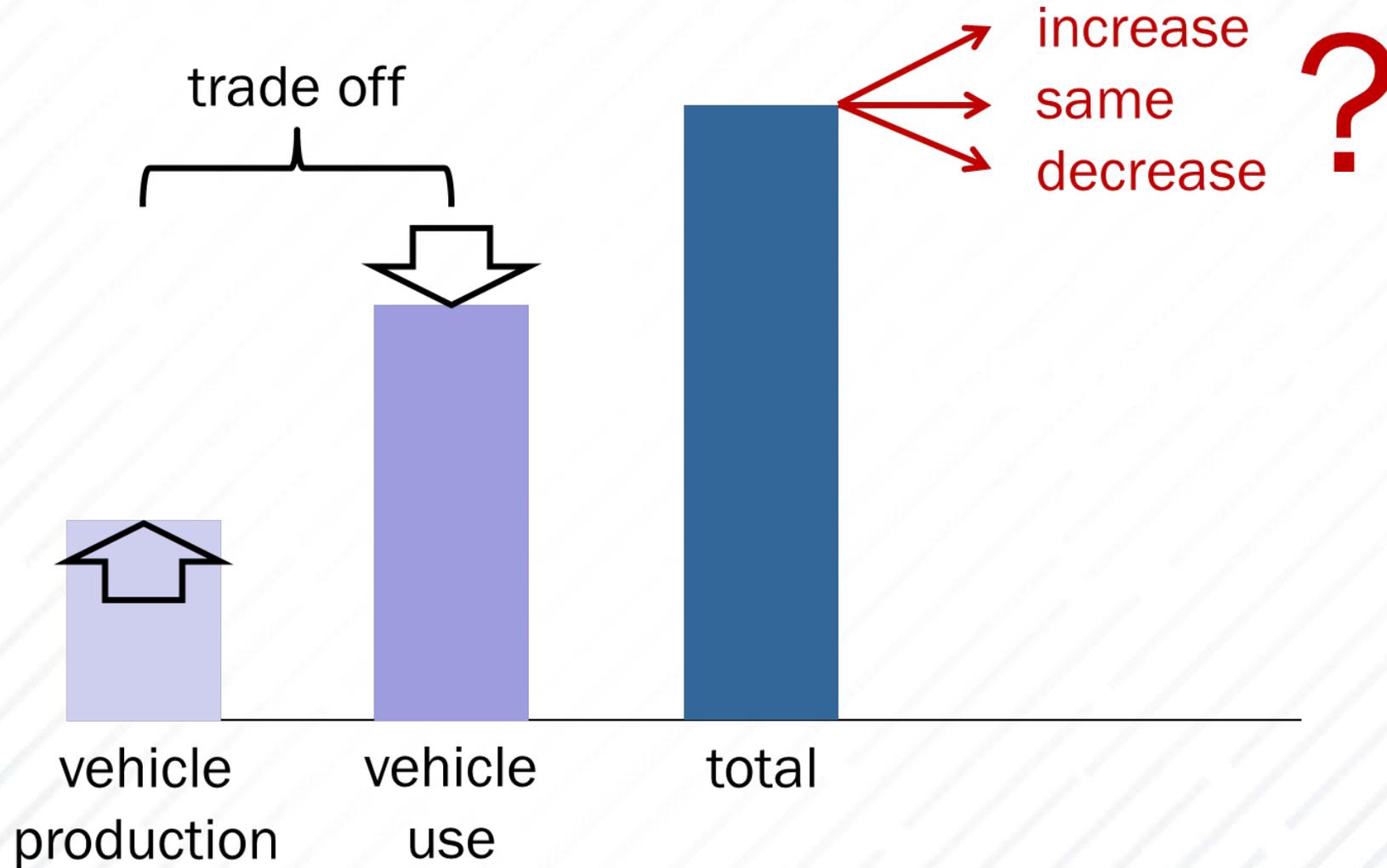


Image Source: R. Geyer, GDIS 2016



## Life Cycle Greenhouse Gas and Energy Study of Automotive Lightweighting

**FINAL REPORT**

November 7, 2017

Prepared by:

Brandie M. Sebastian, LCACP  
Director, Life Cycle Assessment

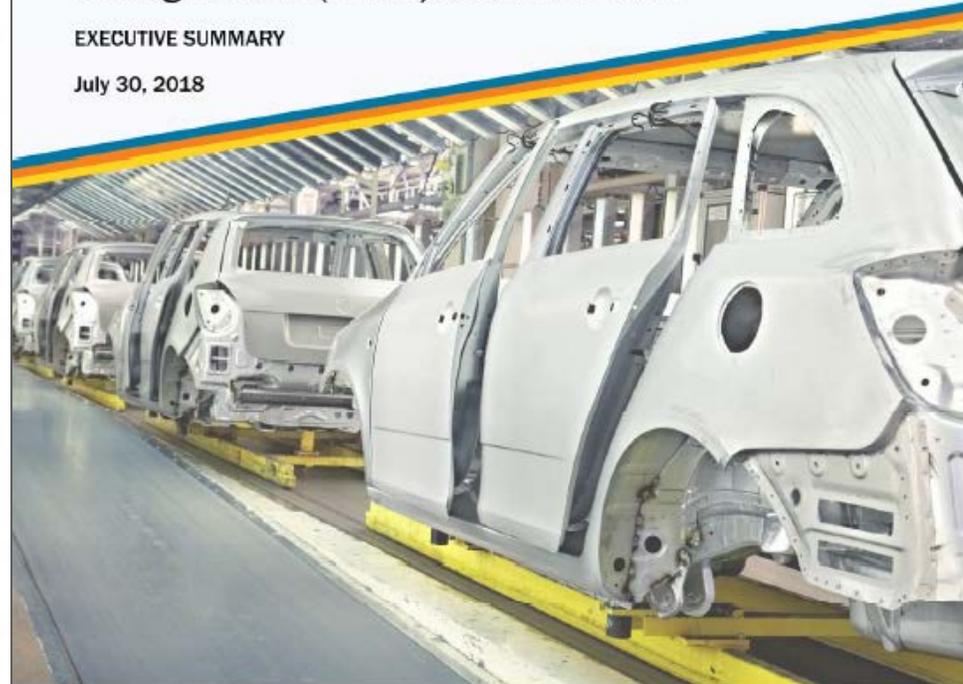
Mark A. Thimons  
Vice President, Sustainability



## Consequential Life Cycle Greenhouse Gas Study of Automotive Lightweighting with Advanced High Strength Steel (AHSS) and Aluminum

EXECUTIVE SUMMARY

July 30, 2018



**Prepared by:**

Brandie Sebastian, LCACP  
Director, Life Cycle Assessment  
Steel Recycling Institute

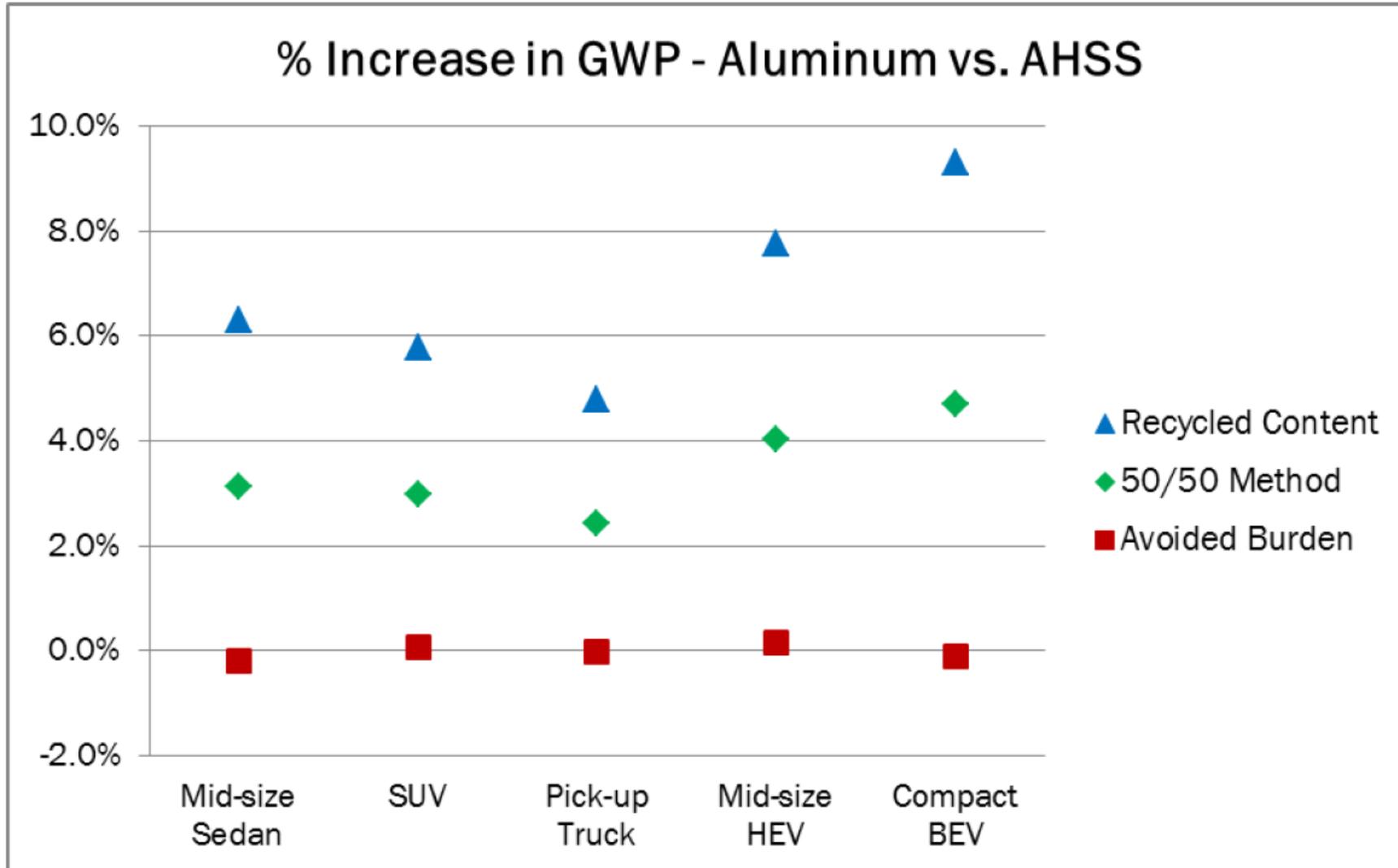
Mark A. Thimons  
Vice President, Sustainability  
SMDI

Kishore Mahubani  
Sustainability Analyst  
Steel Recycling Institute

# ATTRIBUTIONAL LCA STUDY

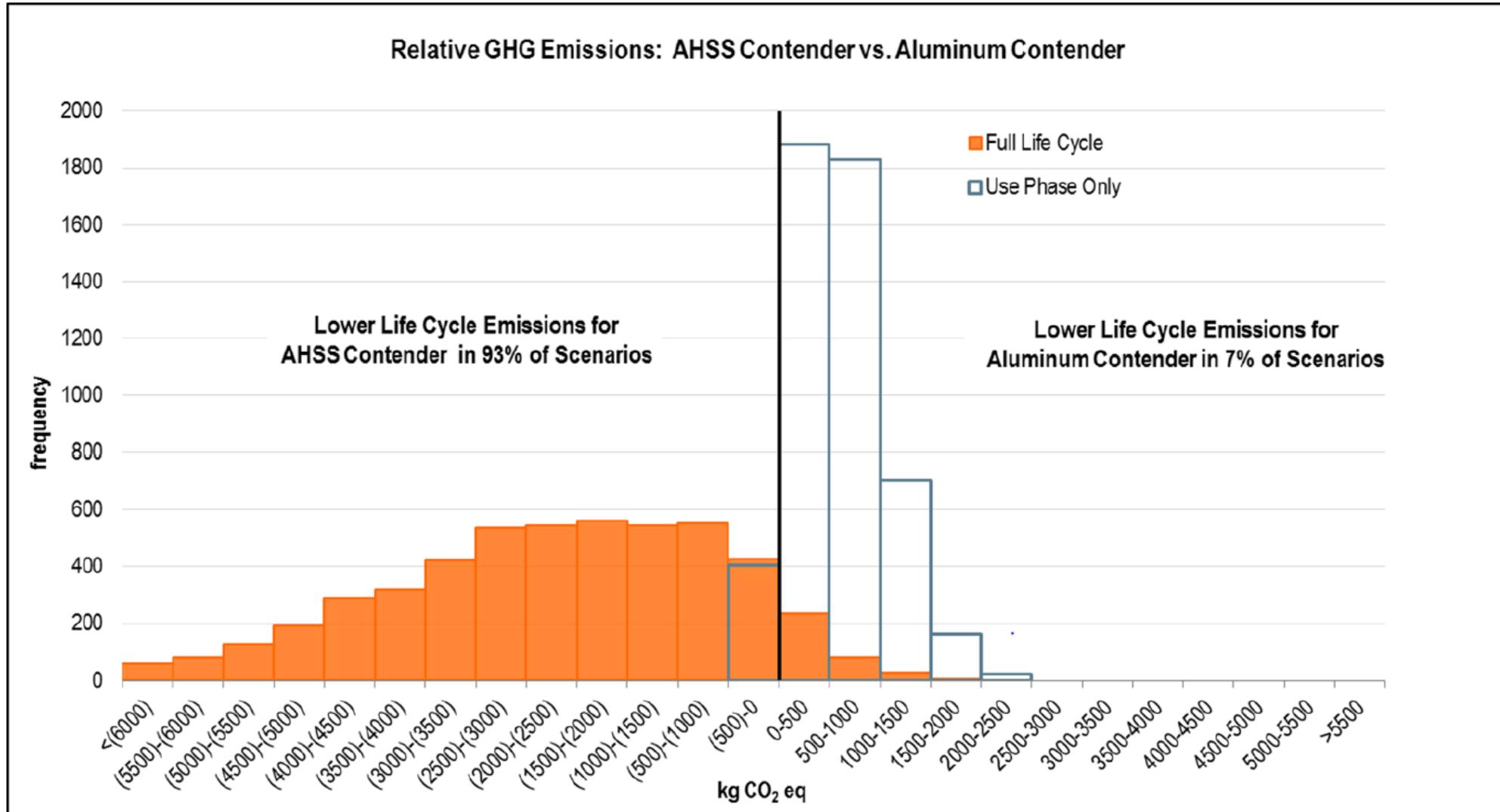
- Calculate total GHG emissions and energy demand of vehicles with body and closures lightweighted with AHSS or aluminum
- UCSB Automotive Materials Comparison Model v5
  - Excel-based – open, transparent, parameterized
  - Free to download from WorldAutoSteel website
- Vehicles assessed: mid-size sedan, SUV, pick-up truck, mid-size HEV, compact BEV
- Current and conservative input parameters
- Sensitivity and Monte Carlo analyses
- ISO critical review by panel of automotive LCA experts

# ATTRIBUTIONAL LCA STUDY RESULTS



Note: GWP = Global Warming Potential, or aggregated greenhouse gas emissions

# ATTRIBUTIONAL LCA STUDY RESULTS

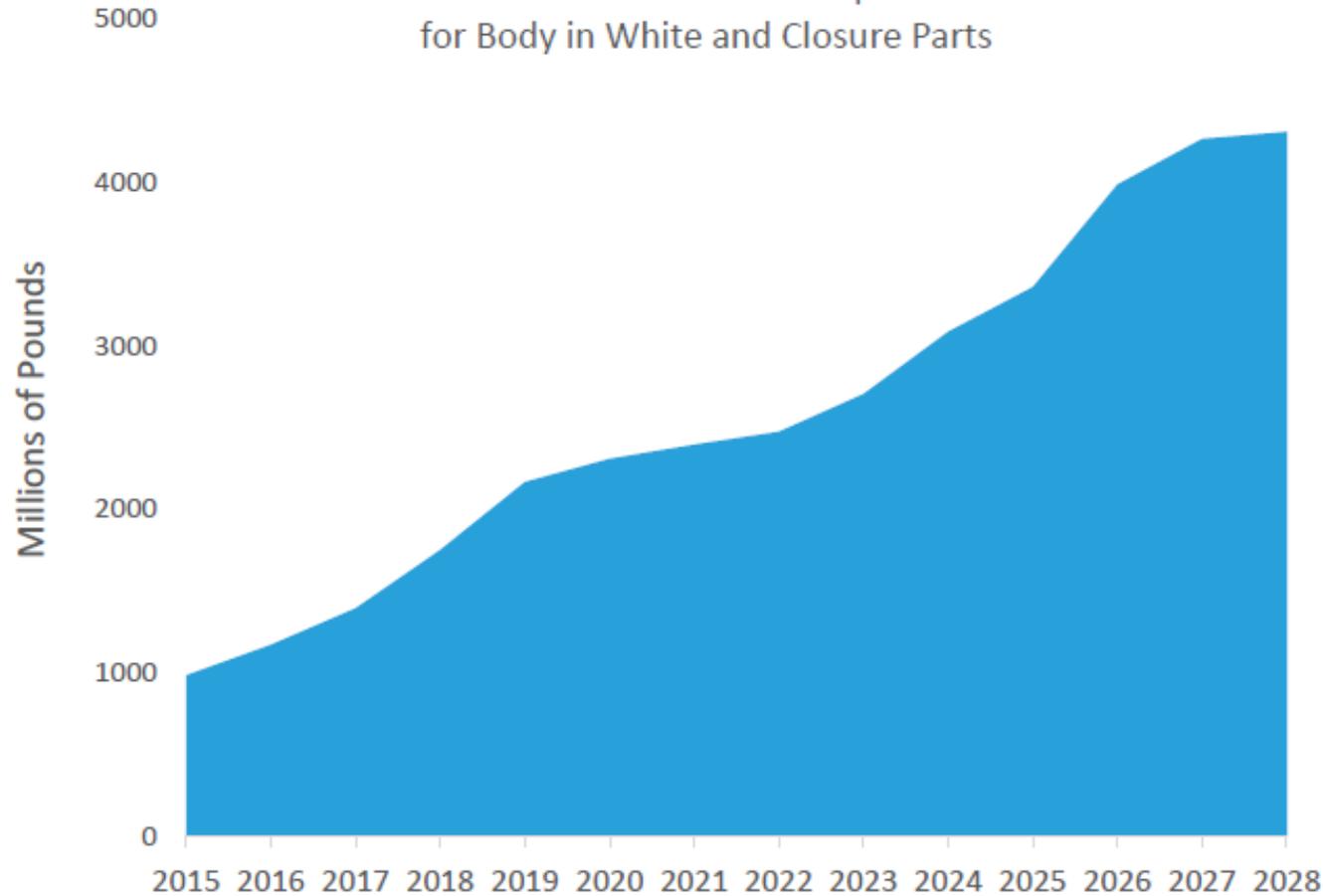


# ATTRIBUTIONAL LCA STUDY FINDINGS

- Lightweighting with aluminum significantly increased production GHG emissions (~30 - 60%) for all vehicle types and in every scenario
- This increase is not offset by emission reduction benefits during the use phase until at least the end of the vehicle's useful lifetime, if at all, and only when using the most favorable recycling methodology assumptions
- The life cycle differences between the contender vehicles in this study represent single vehicle-to-vehicle comparisons and would be amplified when considering the total production volumes for each vehicle type
- Conclusion: Concentrating exclusively on use phase (driving) emissions does not achieve an overall reduction in emissions with any degree of certainty

# CONSEQUENTIAL LCA STUDY

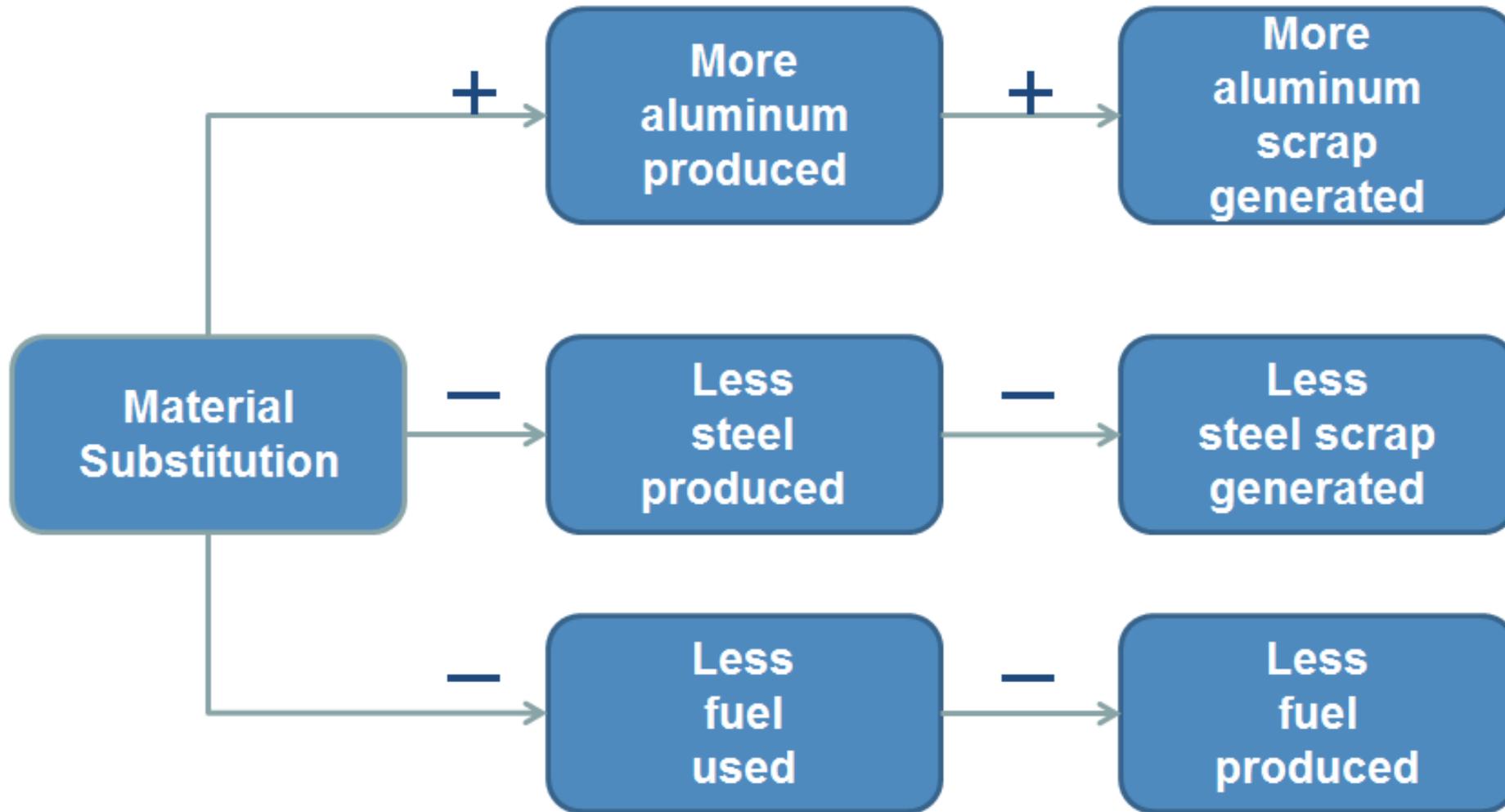
Gross Aluminum Sheet Shipments  
for Body in White and Closure Parts



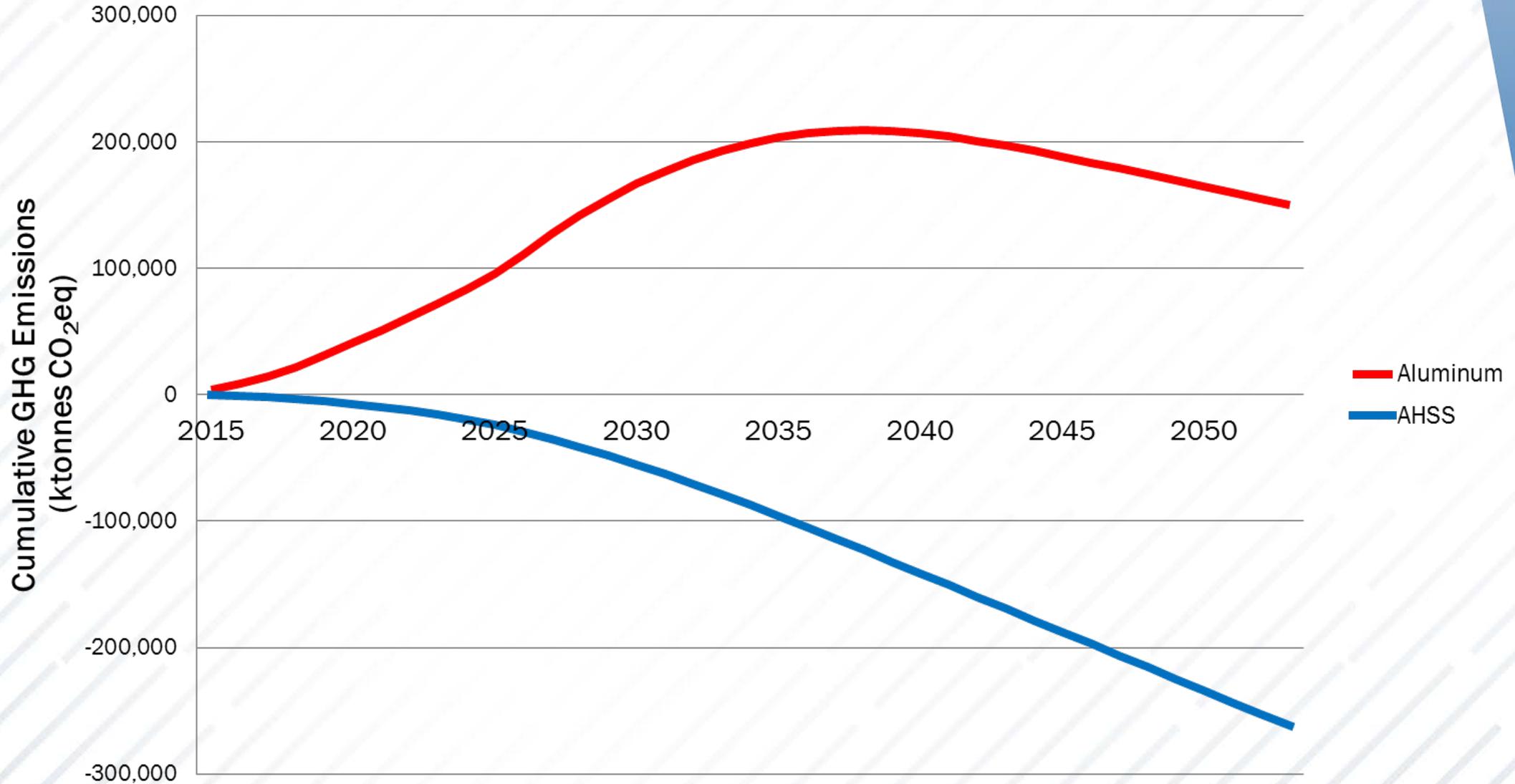
- Vehicle-to-vehicle comparisons may not capture complete environmental effects
- CLCA assesses long-term implications of a significant increase in use of aluminum for lightweighting
- GHG-focused custom-designed Excel model developed by Dr. Roland Geyer

Source: Ducker Worldwide, Aluminum Content in North American Light Vehicles 2016 to 2028, Summary Report, July 2017.

# CONSEQUENTIAL LCA STUDY



# CONSEQUENTIAL LCA STUDY RESULTS



# CONSEQUENTIAL LCA STUDY FINDINGS

- The projected aluminum increase to lightweight the vehicle fleet in this study results in a significant cumulative increase in GHG emissions, even when use phase savings and GHG benefits due to recycling are considered
- The increase in GHG emissions for the aluminum base case is not offset by use phase savings and GHG credits for recycling aluminum scrap until 2084, more than 65 years in the future
- Alternately, if the body and closure components of the vehicles in this study were instead lightweighted with AHSS, the result is an immediate and continuous decrease in cumulative GHG emissions

# SUMMARY

- Automakers are employing material substitution to achieve (somewhat uncertain) fuel economy targets
- Use of GHG-intensive lightweighting materials:
  - Causes higher GHG emissions initially
  - Can result in higher total vehicle life cycle emissions
- Ensuring improvements in production phase emissions while reducing driving phase emissions avoids unintended consequences
- Improving fuel economy and future mobility trends will further emphasize the importance of material selection

# THANK YOU / FOR MORE INFORMATION

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