



Aluminum Superior
in ...
Shedding Mass
Boosting MPG
Reducing CO₂

Global Automotive Lightweight
Materials Conference
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Introduction



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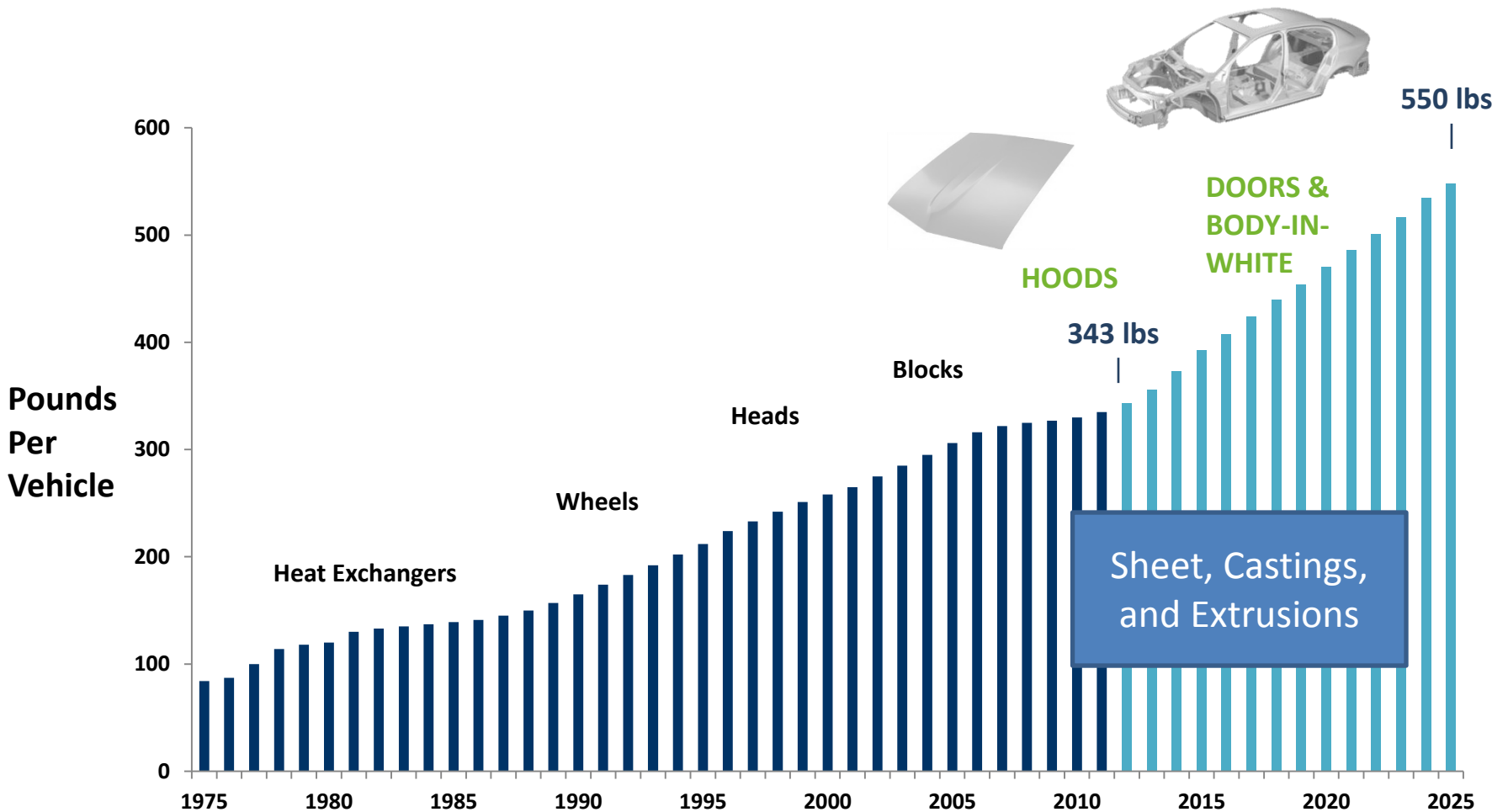
Outline

Market Overview

**Study 1 | Mass reduction potential with aluminum in a
Toyota Venza**

Study 2 | CO₂ Life Cycle Assessment of Aluminum in Cars

Aluminum Use in Vehicles Accelerating



Source: Ducker Worldwide 2011

Aluminum Bodies on the Road



Tesla Model S

- *World Car of the Year Award Winner*
- *Automobile Magazine's Car of the Year*
- *5 Star Safety Rated*



Range Rover

- *World's First All-Aluminum SUV*
- *39% lighter body*



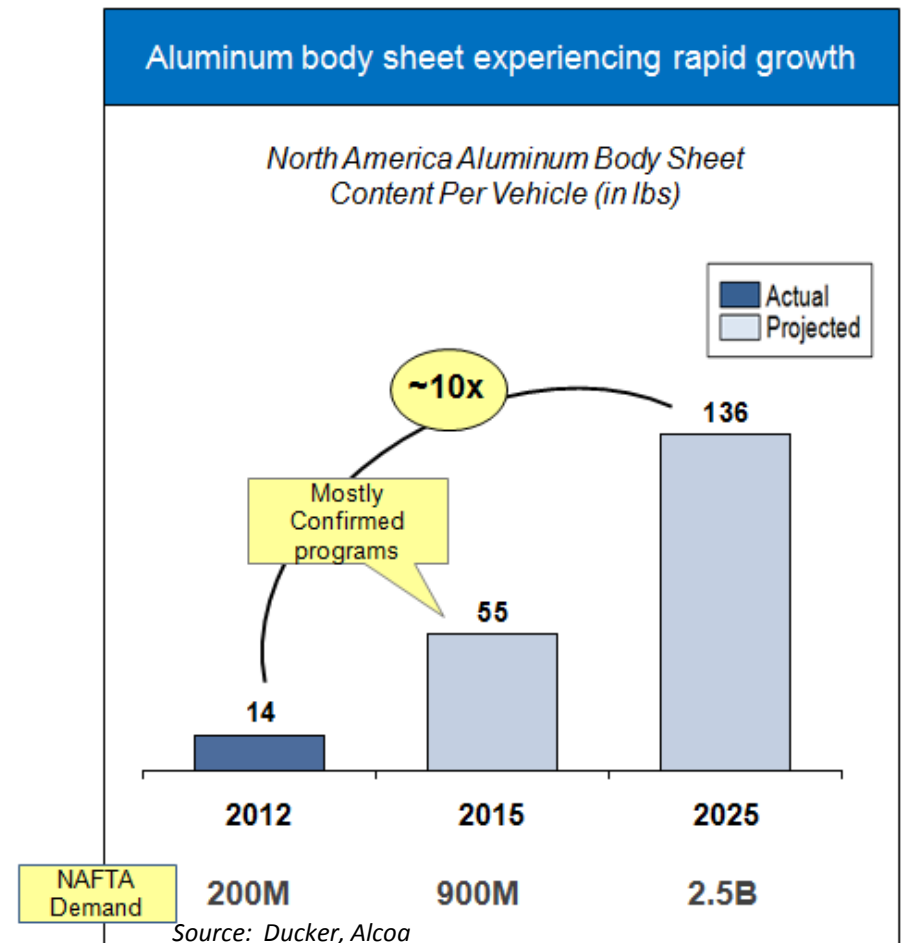
Corvette Stingray

- *Aluminum Frame 100lbs lighter than prior*
- *57% stiffer*

**Next Step...
Mass Market Car?**

Supply Considerations

- Massive auto aluminum growth wave is about to hit in North America
- Ample primary metal supply
- Sheet, casting, and extrusion suppliers are ramping-up rapidly
- Early involvement of supply base is critical (3+ yrs ahead of SOP) to ensure infrastructure is in place



Study 1 | Aluminum Toyota Venza

Objectives

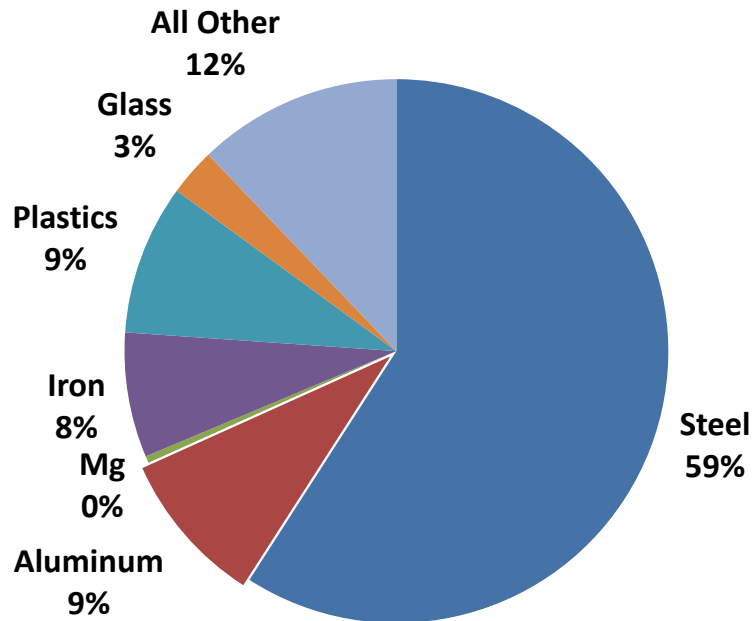
1. Use same baseline Venza as used by EPA in their study of MODERATE weight reduction potential
2. Target an aluminum-intensive body
3. Retain: size, functionality, safety (5★), NVH, performance, etc.
4. Materials and processes available and practical by 2017
5. Highly respected 3rd party analysis



Source: ATG AIV

Result: Major Shift in Material Mix

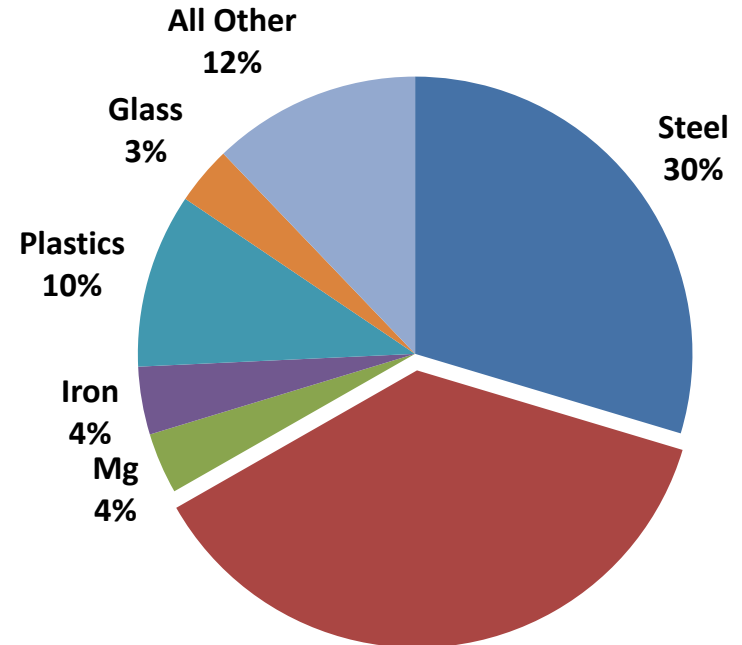
Baseline Venza



Total Mass:
1,711Kg

**28% Mass
Reduction**

Venza AIV



Total Mass:
1,237 Kg

Comparing to the Moderate case

	Baseline	Multi-Material (MMV)	Aluminum (AIV)
Closure Material	Steel	Aluminum	Aluminum
BIW Material	Steel	Steel	Aluminum
Body & Closure Mass Reduction	-	(14%)	(39%)
Total Vehicle * Mass Reduction	-	(18%)	(28%)
Cost Impact *	-	(- \$ 0.47 / Kg)	(+ \$1.12 / Kg)
Fuel Economy Impact *	-	+3.1 MPG	+4.8 MPG

* Note: Full Vehicle Mass Optimization

Summary

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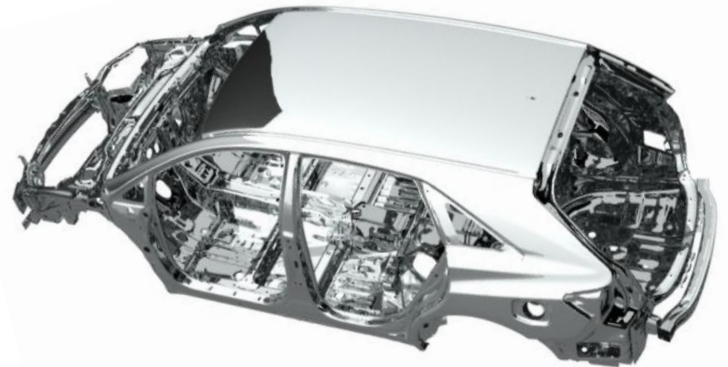
Aluminum intensive mid-size cross-over SUV can meet all design objectives: size, functionality, safety, NVH, performance

28% (476 Kg) total mass reduction

— aluminum – BIW, closures, chassis, suspension, brakes

Estimated cost impact: **+\$534 (\$0.51/Lb)**

FE impact: **+4.8 MPG fuel economy**
(from 27 to 31.8 MPG)



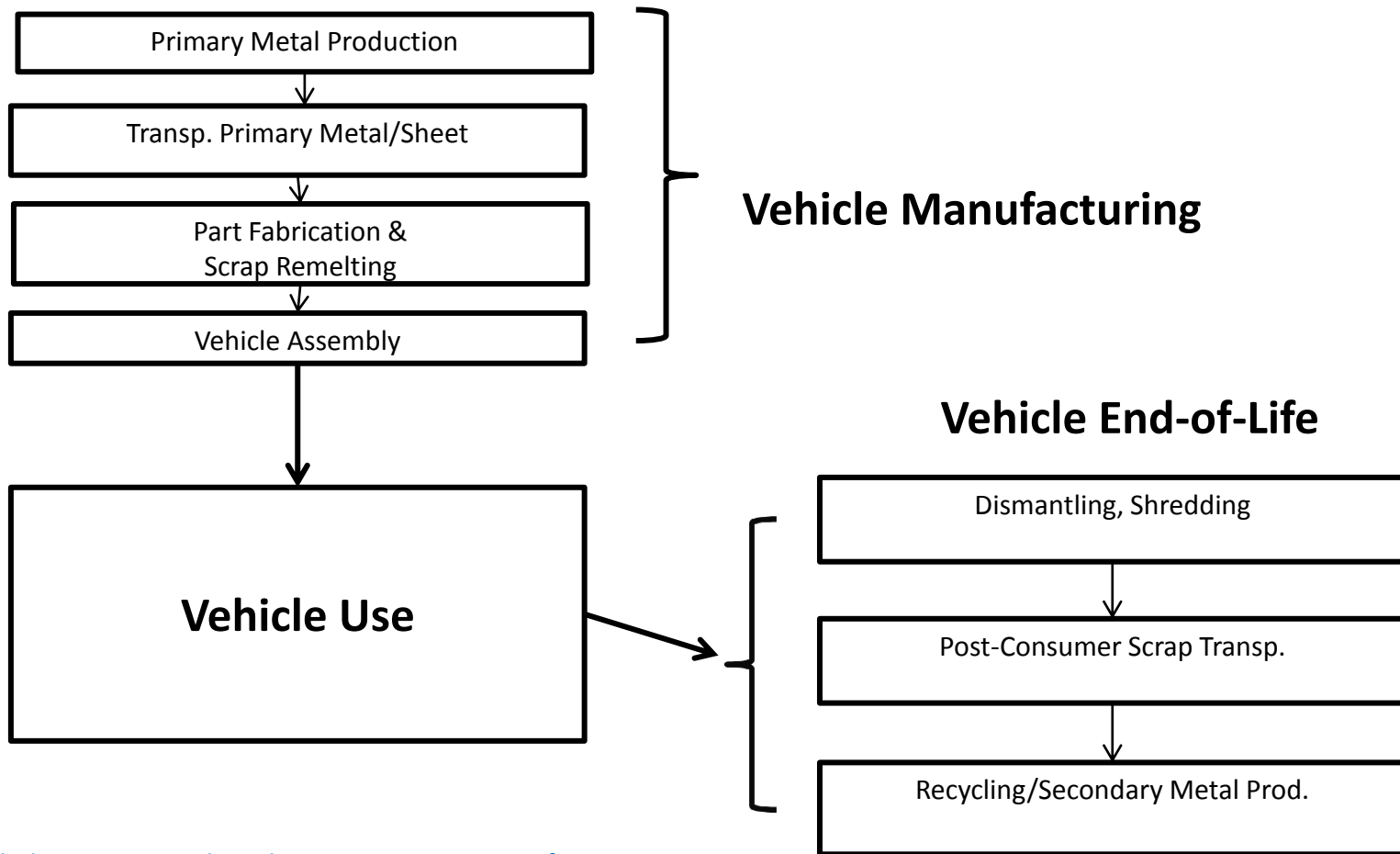
Study 2 | Automotive Aluminum Life Cycle Assessment

Oak Ridge National Lab comparison of environmental performance of:

- **Baseline Toyota Venza (Current production)**
1711kg
- **Moderately lightweighted Toyota Venza (LWSV)**
1399kg
- **Aluminum-intensive (AIV) Toyota Venza**
1236kg

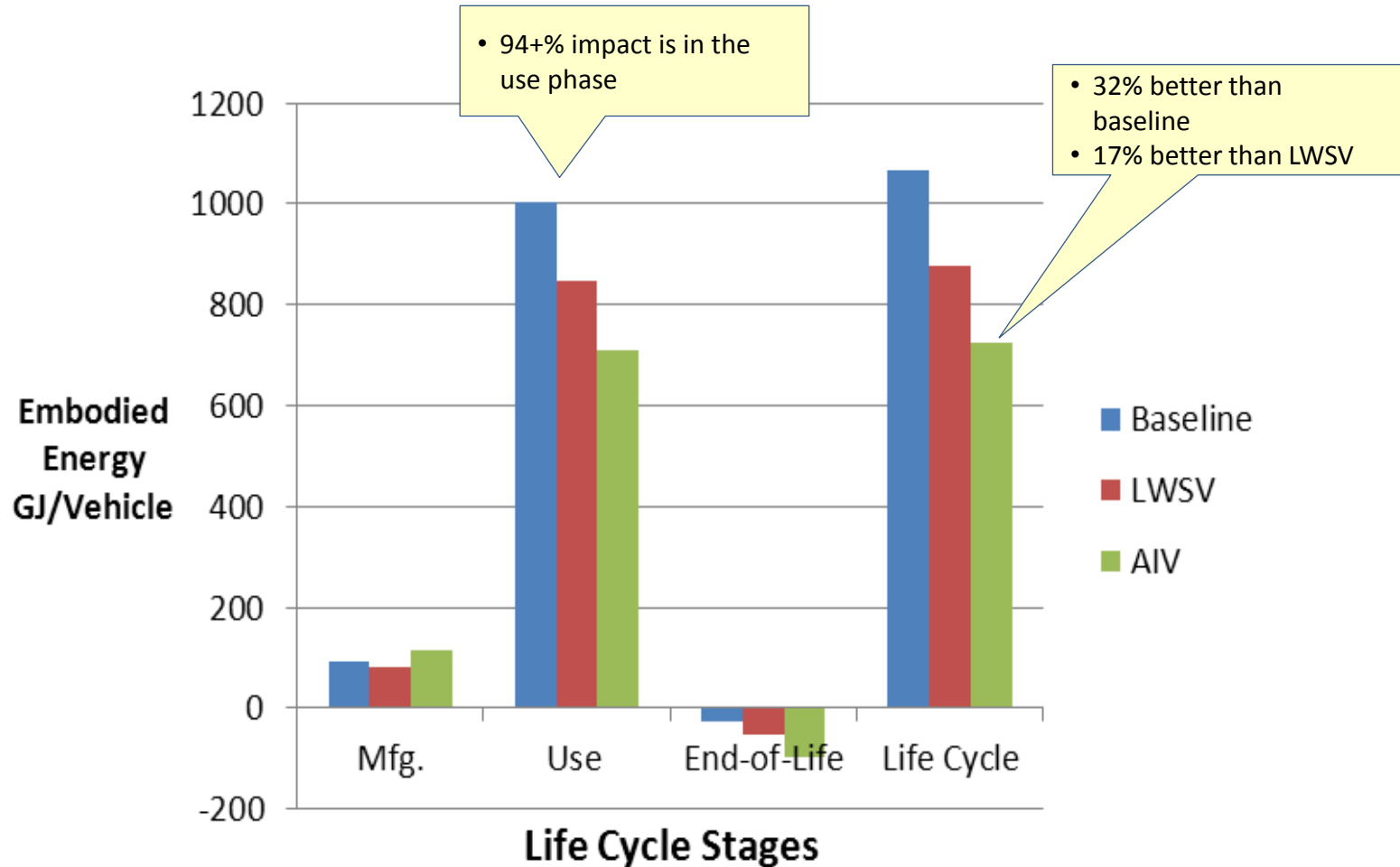
Automotive Aluminum CO₂ Life Cycle Assessment

Vehicle Life Cycle Stages



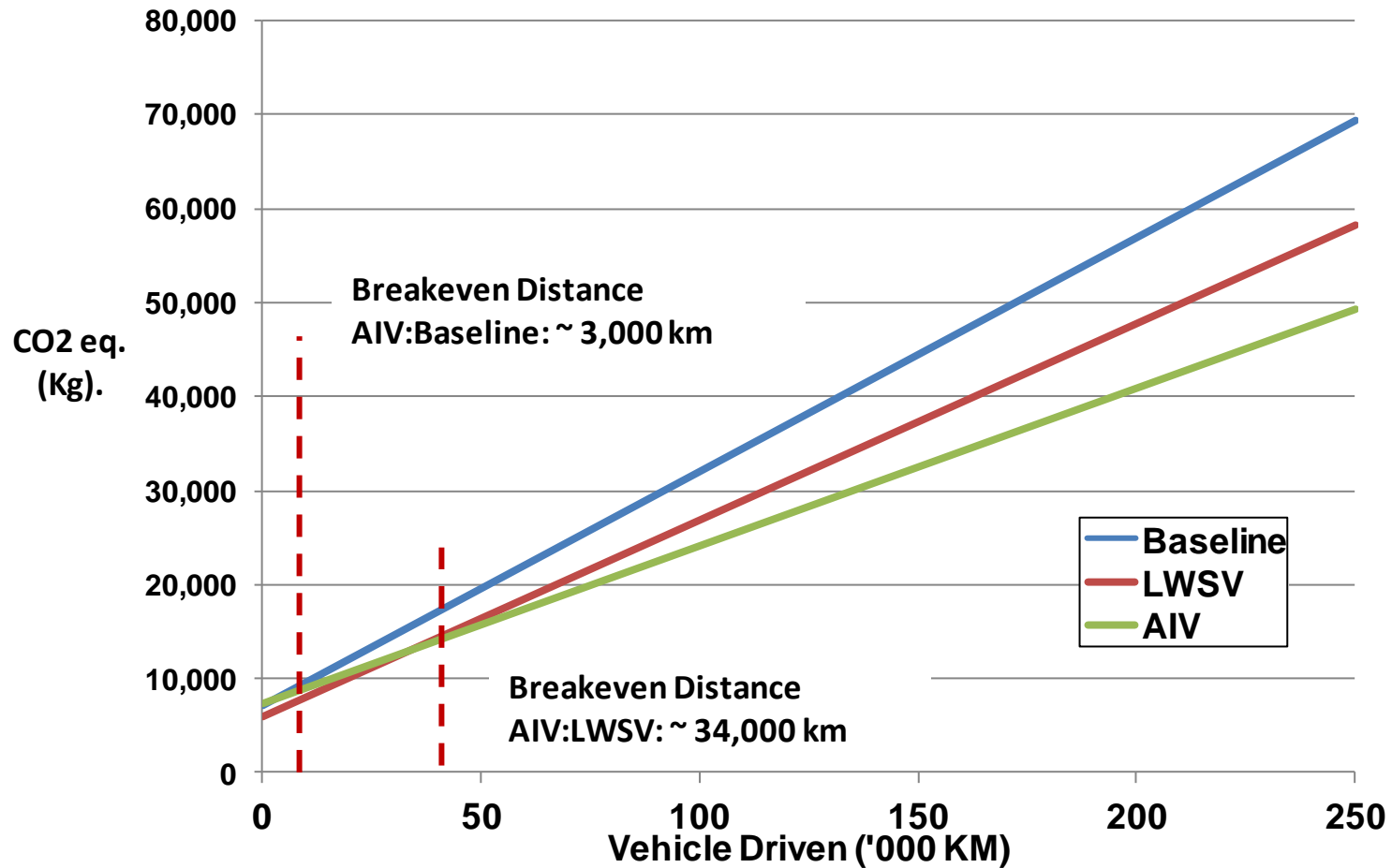
Avoided Primary Metal Production Occurs at Manufacturing (prompt scrap) and End-of-Life (post-consumer scrap)

Life Cycle Energy Findings



Note: Based on Baseline 1168 kg Components of a 1711 kg Curb Weight Vehicle

CO_{2e} Breakeven Analysis



Summary

Fact	Metric	Source
Shift to aluminum is accelerating	10X by 2025	Ducker
Aluminum saves more weight than steel can	28% vs. 18%	EDAG
Aluminum is cost effective	\$.51 / lb saved	EDAG
Lower lifecycle energy	32% Lower	ORNL

www.drivealuminum.org



Questions ?

Thank You!

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