

Replaceable LUXEON Go light source modules,
easing repairability in a sustainable headlamp architecture

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From Conventional Light Sources to LED Light Sources

From regular exchange to car lifetime

Typical lifetime: 500...1000h → Regular Exchange



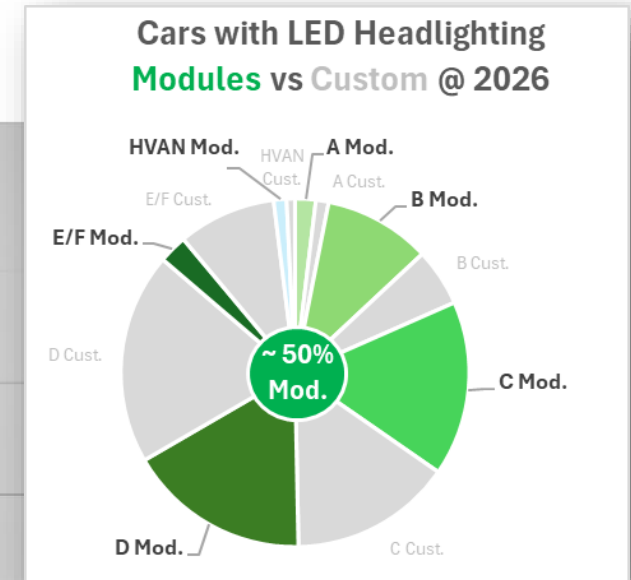
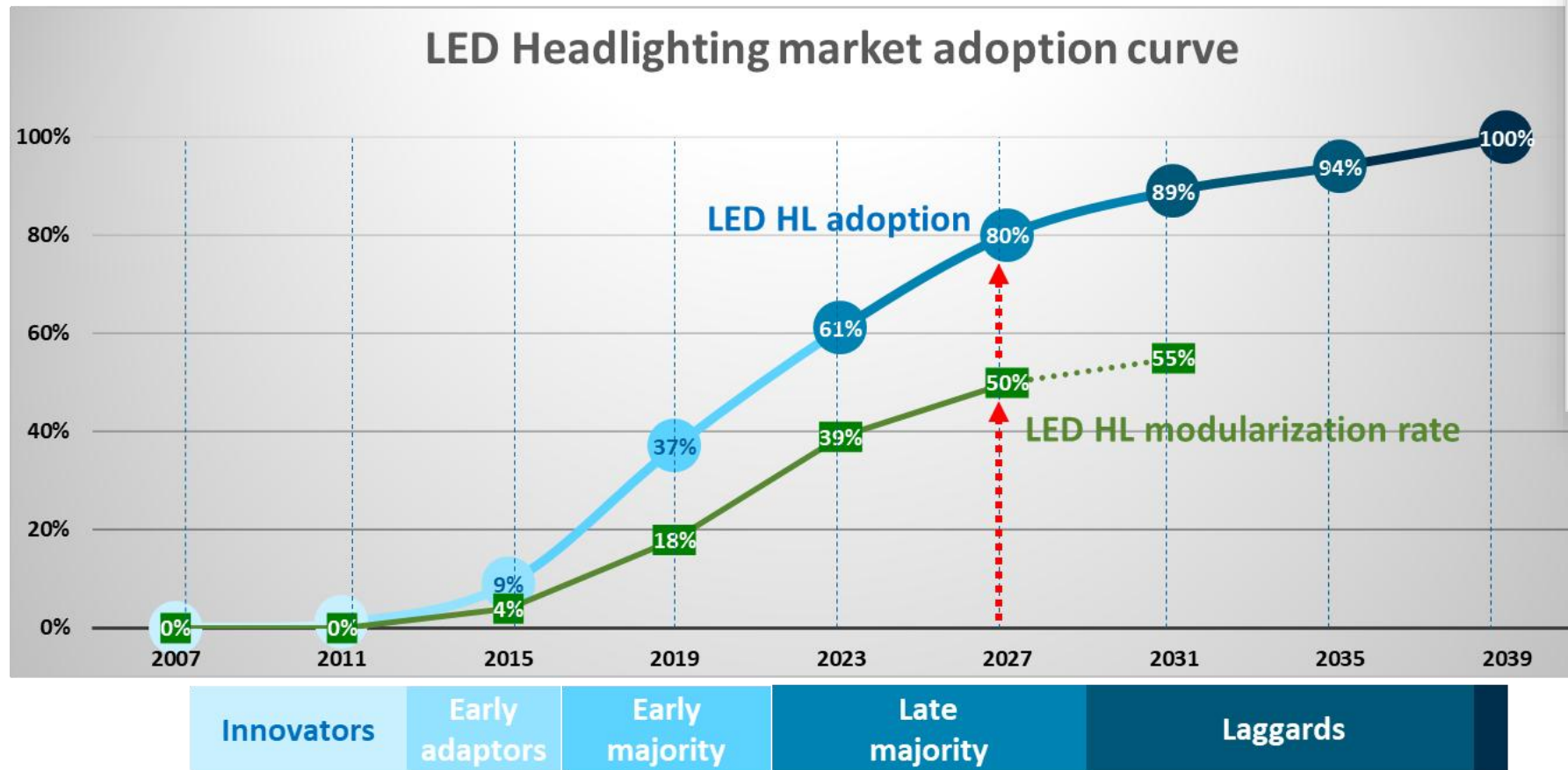
Typical lifetime: > 10.000h → Car Lifetime



Car Life : $300.000 \text{ km} \div 40\text{km/h} = 7500\text{h}$ (100% light on)

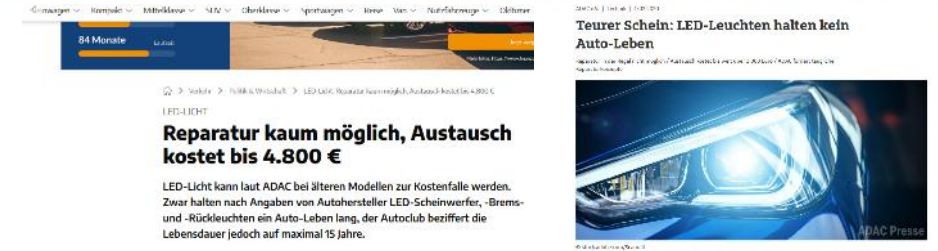
LED Headlighting Market Adoption & Modularization Trend

- LED headlighting adoption has reached full market maturity
- Solution modularization is becoming increasingly important



Source : Lumileds market model; based on S&P LV production data

LED Headlamp replacement costs



Premium Car Segment

Vehicle	LED Headlamp Replacement Cost	Typical MSRP / Value	% of Car Value*
BMW 3-Series / X3	~\$3,000+*	~\$45,000	~5–7%
Volvo XC90	~\$2,800	~\$65,000	~4–5%
Tesla Model 3	~\$1,000+	~\$42,000	~2–3%
High-end OEM / adaptive matrix LED**	~\$3,000–\$6,000+	~\$80,000+	~4–8%+

*Multi-LED/adaptive assemblies including modules and control electronics can push pricing much higher
 **In vehicles with advanced *matrix* or *adaptive* LED lighting, real world costs (dealer quotes) can exceed these figures depending on options and calibration requirements.



Main stream Car Segment

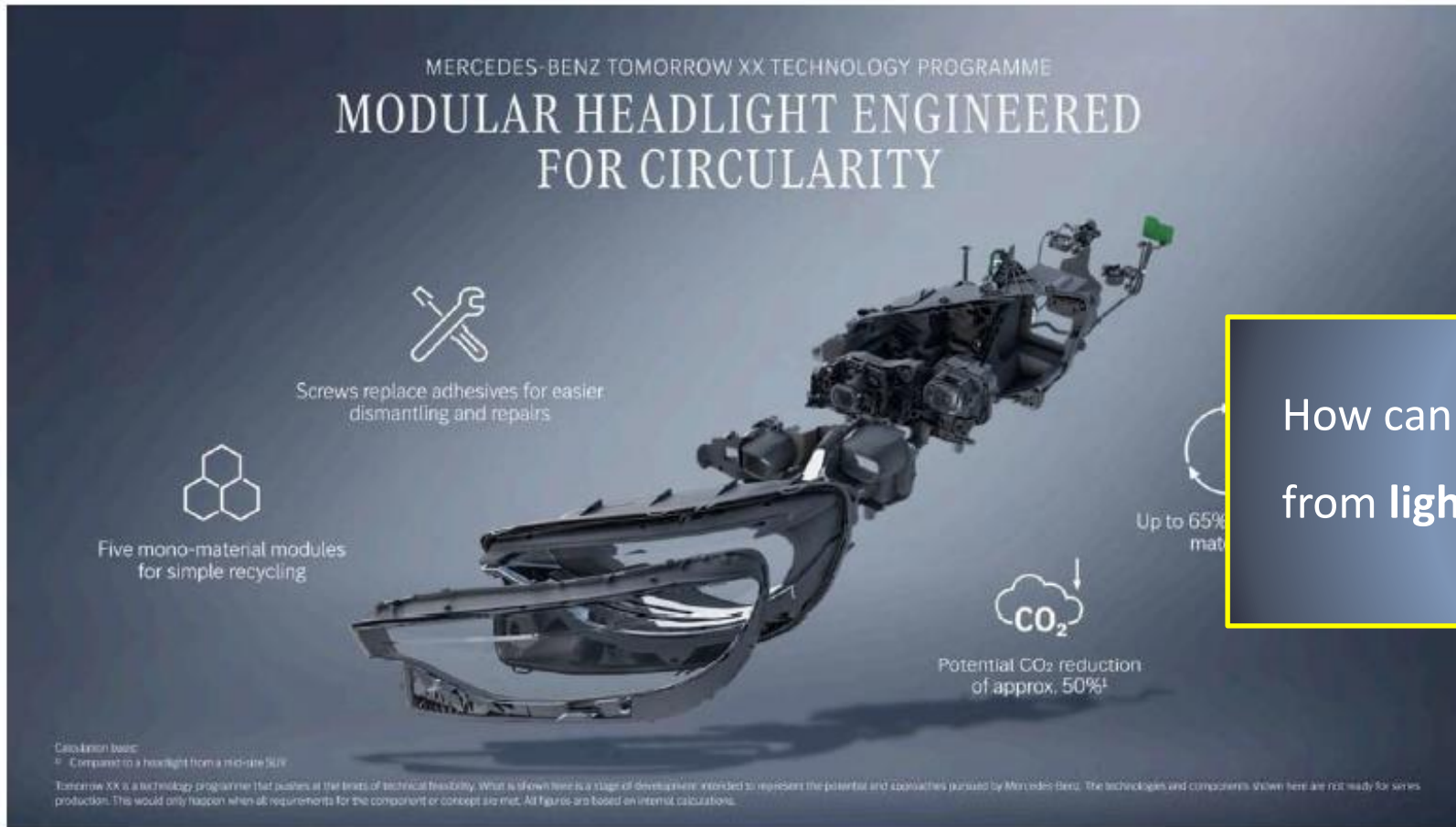
Vehicle	LED Headlight Replacement Cost	Typical MSRP / Value	% of Car Value*
Toyota Corolla (LED assembly)	~\$600–\$900	~\$20,000	~3–5%
Hyundai / Kia mid-range SUV	~\$675–\$900	~\$25,000	~3–4%
Subaru Forester	~\$600–\$900	~\$27,000	~2–3%
Toyota Corolla (aftermarket LED pair)	~\$486	~\$20,000	~2–5%

Examples are LED headlamp module costs (parts only); does not include labor (often adds \$100–\$400)

Data source: Online internet search

How modularization supports “Repairability” & “Circularity”

„Separation“ is a key requirement



Data source: DVN Newsletter #936

LUXEON Go: Standard headlighting modules with well-defined interfaces

Technical features supporting repairability and circularity / Compatible with UN ECE R149

Electrical

Configurable
PCBA

Optical

TopContact LED
1x2,...,1x5



Thermal

Standard heatsink designs
1x2, 1x3, 1x4

Mechanical

Referencing system +
Fixation



Fast time to market



Compactness & low weight



High efficiency / low energy



Easy to use



Simplified supply chain

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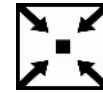
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Repairability

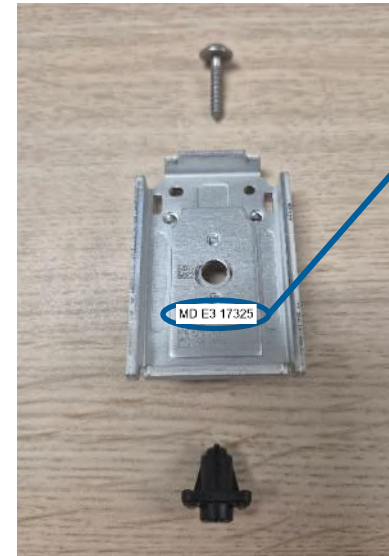
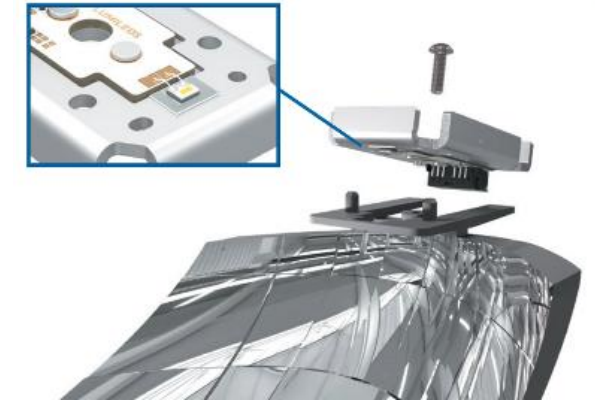


Recycling

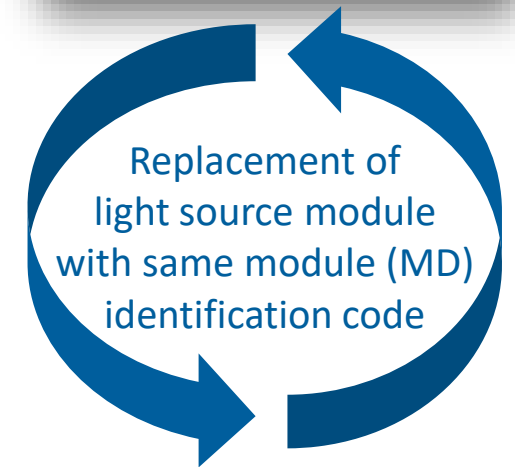
LUXEON Go modules enable easy separation and repairability

Today's solution

- Headlamp according to **UN ECE R148** allows replaceable light sources, light source modules and/or non-replaceable light sources
- Light source modules can be **replaceable** or non-replaceable



MD E3 17325



Future option

- **UN ECE regulated end-user replaceable light source:**
LED Headlighting light source category proposals "L2" & "L3" (under R.E.5 ; UN-ECE)

LUXEON Go: Comprehensive portfolio for reflector headlighting

- **LUXEON Go** : Reference range for reflection applications

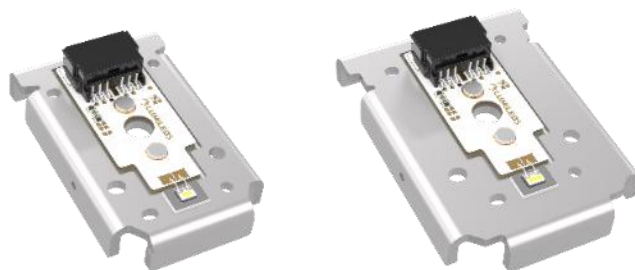


4 standard heatsink designs
+ customized versions

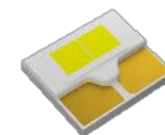


1x2, 1x3, 1x4, 1x5, 1x5L

- **LUXEON Go H**: Extended portfolio with alternative referencing system and flat heatsink design



2 standard heatsink designs



1x1, 1x2, 1x3, 1x4

- **LUXEON Go S** : NEW slim & ultra compact module for 2-wheelers and compact 4-wheelers

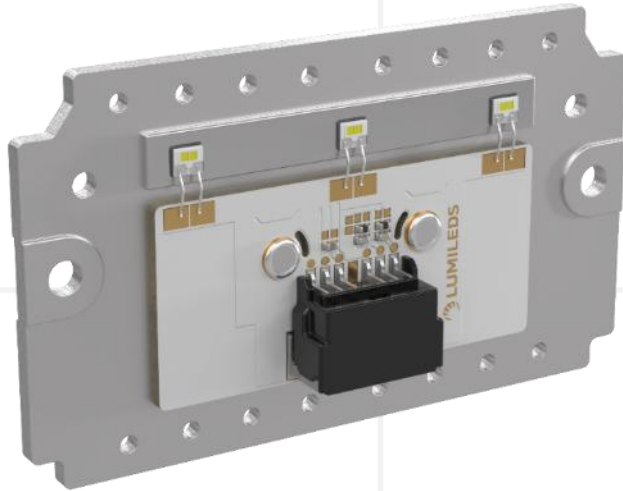
LUXEON Pro – modular solution for projection headlighting applications

Electrical

Configurable PCBA

Optical

TopContact LEDs



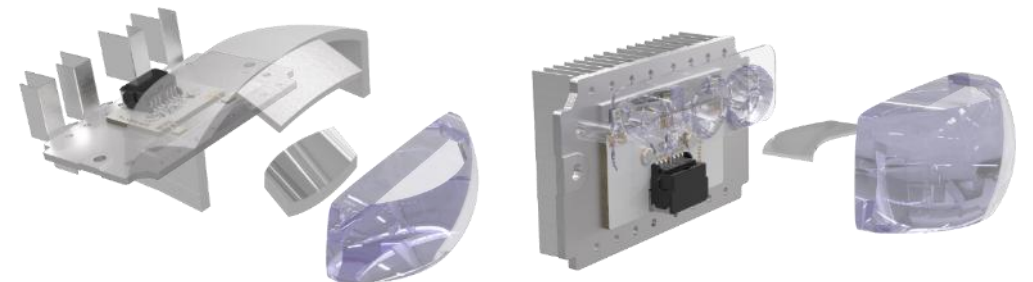
Thermal

Standard base plate
(extendable)

Mechanical

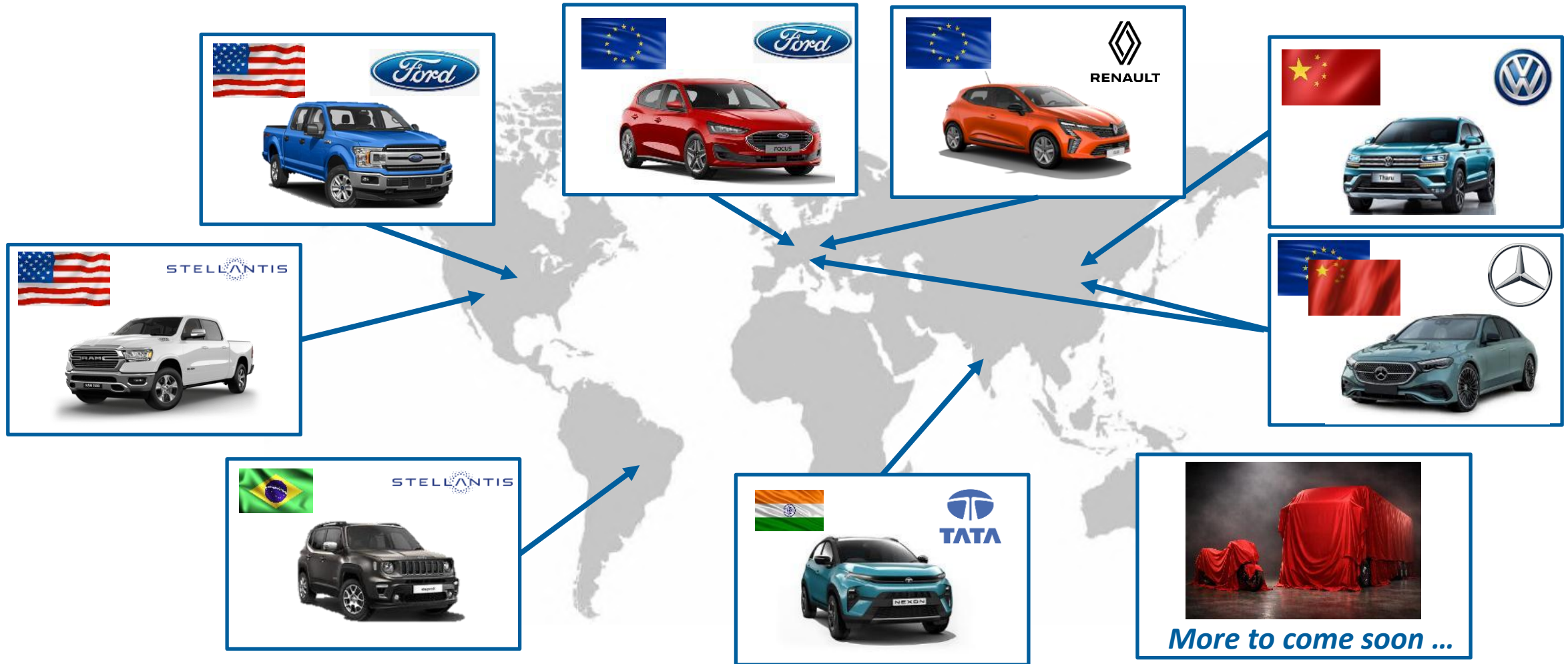
Referencing system
+ Fixation

- Variable number, types and arrangement of TopContact LEDs
- Single and dual row design possible
- Extension of heatsink with customizable elements
- Standard base plate enabling economy of scale



Proven Track Record in the market

Key OEM global platforms on the road, featuring LUXEON Go modular solution approach





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