

# FREE-FORM MICRO OPTICS

## AUTOMOTIVE EXTERIOR LIGHTING INSIGHTS

Paul-Henri MATHA

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# What are the usage ?

Headlamp

Rearlamp

Interior lighting



Extract from Arkema presentation

# What are the stakes ?

Signaling functions

Lighting functions

# 1) Signaling functions



*XC90 Thors's Hammer*

# 1) Signaling functions

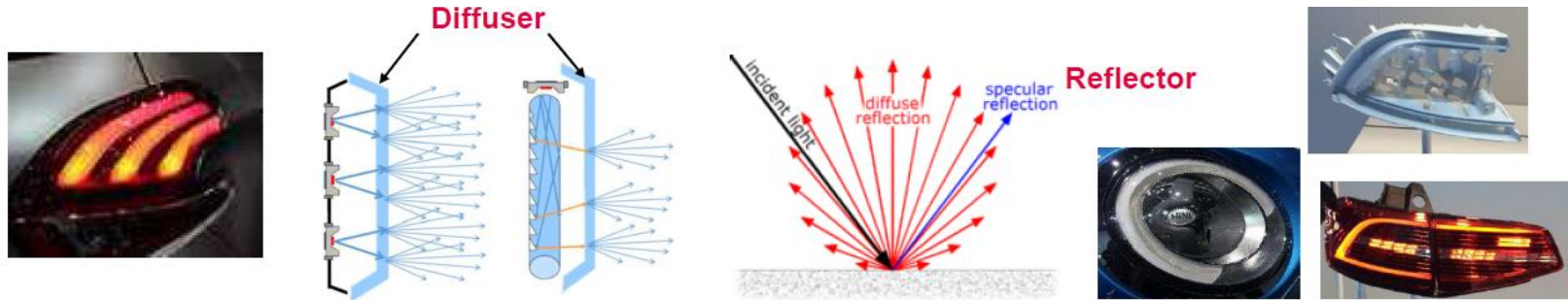
- What do we need ?
  - To fulfil legal requirement : Candela values in different axis
  - Styling request : good homogeneity
  - Low power consumptions



# 1) Signaling functions – current solutions

Diffuser or Reflector technology :

- Transmittance
- Reflectivity
- Diffusive material with high optical efficiency
- No color shift when long plastic part (> 500mm)



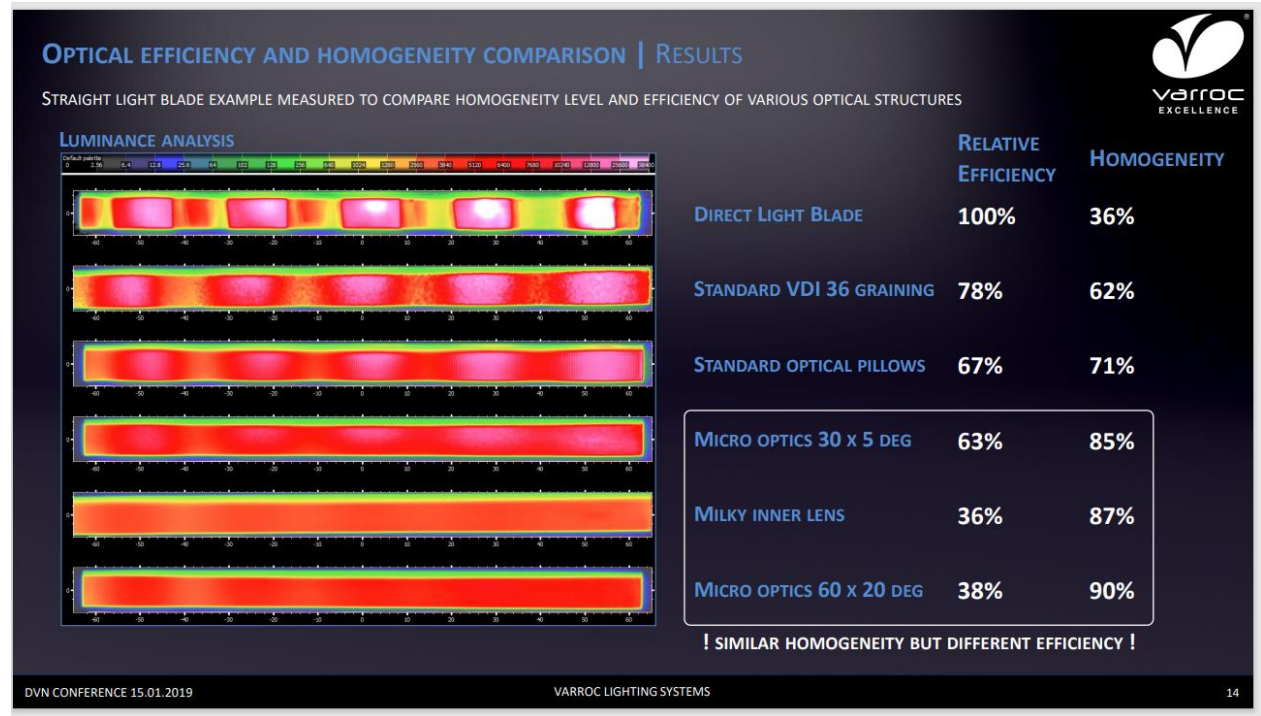
*Extract from Arkema presentation*

# 1) Signaling functions – current solutions



Bulb	LED reflector	LED light guide / multi screen
50 W / car	10-20 W / car Optical efficiency ~ 50%	30W – 60W / car Optical efficiency ~ 10%

# 1) Signaling functions – comparison



Extract from Varroc presentation, DVN Rochester January 2019



## 2) lighting

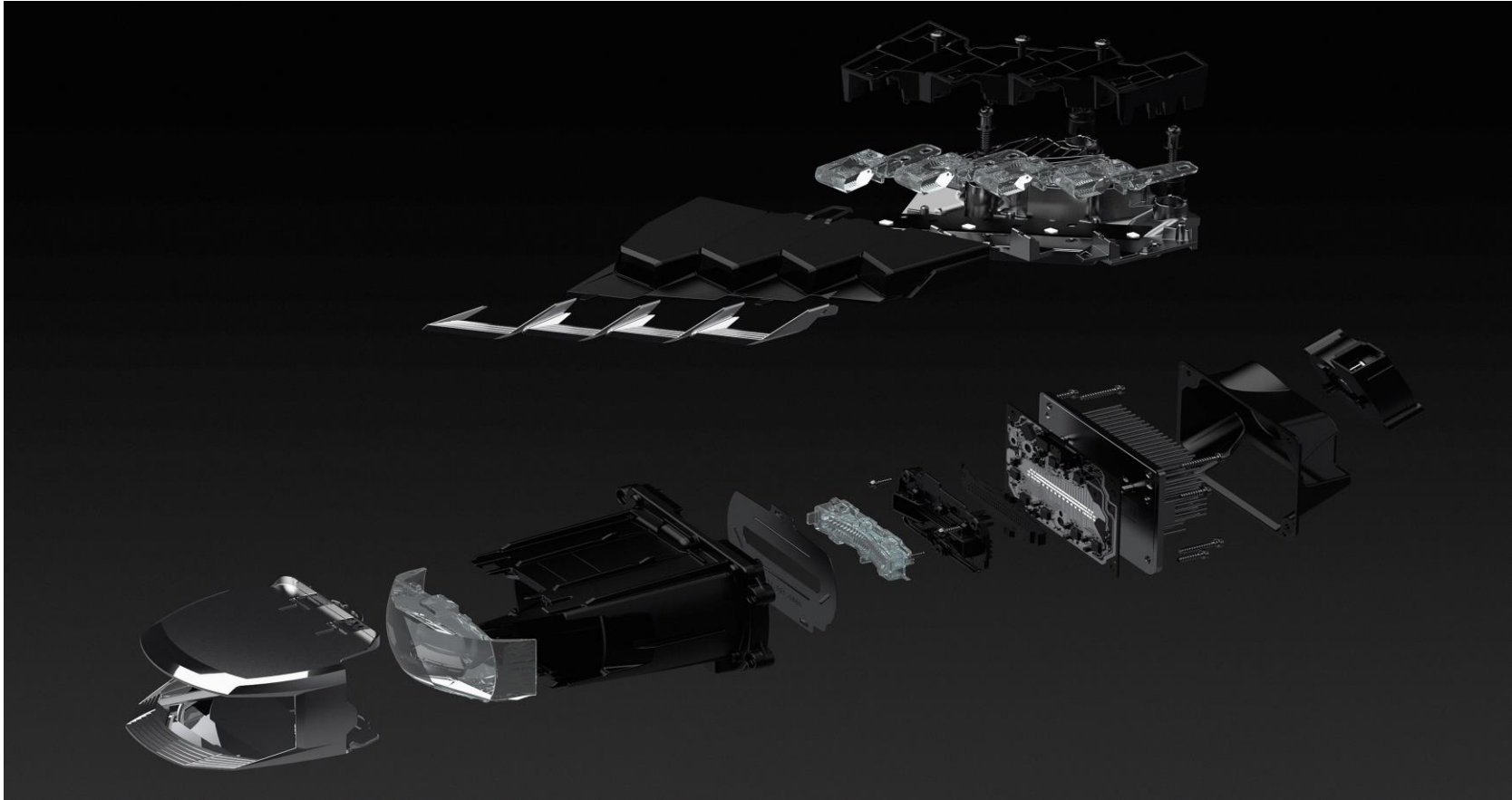
*Polestar 2*



Paul-Henri MATHA, Exterior lighting, Technical leader



An exploded view of the PlayStation 5 DualSense wireless controller, showing its internal components. The main body is black, with a clear plastic cover for the touchpad and buttons. The internal components, including the battery, motor, and sensors, are shown in a disassembled state, revealing the intricate internal structure. The components are arranged in a way that shows how they fit together, with the main body at the top and the internal components below it. The background is black, making the components stand out.



## 2) lighting

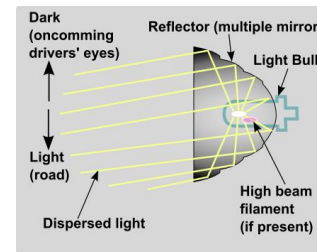
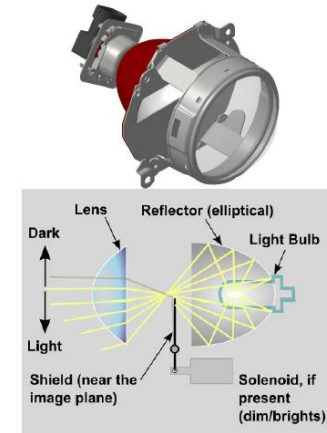
- What do we need ?
  - To fulfil legal requirement : Candela values in different axis
  - Homogeneity of beam pattern
  - Styling request : small size
  - Sustainability : Low power consumptions
  - Packaging : small depth



## 2) Lighting – current solutions

Ellipsoid or parabola system :

No evolution between bulb technology and LED technology



## 2) Lighting – current solutions



Height 100mm – light source ~ 1500 lm



Height 50 - 70mm  
light source ~ 1000-1500lm  
Renault Captur 2020



Height 20mm – 40mm  
light source ~ 2000-3000 lm  
Volvo S90

Bulb	LED system - Entry	LED system – Premium
137 W / car	20-40 W / car Optical efficiency ~ 40-50%	60W – 120W / car Optical efficiency ~ 20-30%

## 2) Lighting – free form optics

Free form micro optics could be a revolution :

- Depth of optical system : target 50mm instead of 100-200mm
- Efficiency : target  $> 50\%$
- Styling : new freedom for design

### 3) Road Projection

Solution done with MLA (Micro lens array) or DLP from Texas instrument

How to reduce drastically the cost with free form optics ?

