novaled

OLED

LIGHTING

for New Lighting Products

A bright future ahead – OLED Lighting

Organic light-emitting diodes offer an entirely new way to create with light:
pure, sophisticated and beautiful.

Organic light-emitting diodes (OLED) are an entirely new way for architects, designers, system integrators, planners and luminaire makers to create with light. OLED devices are ultra-flat and emit very homogeneous light. The OLED grants a high degree of design freedom to users. By combining color with shape OLEDs offer an exciting new way of decorating and personalizing surroundings with light.

Area light source

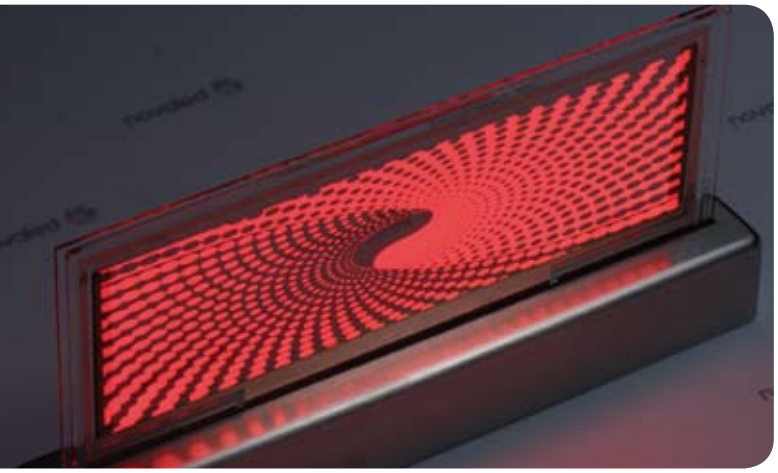
OLED is the only lighting technology capable of creating an embedded light emitting surface. The illuminating surface does not need diffusers or other functional 'wrappings' and can function both as lamp or luminaire.

Ultra slim devices

OLEDs are semiconductor devices made of thin organic material layers with a thickness just 1/50th that of a human hair. The total thickness of the resulting OLED luminaire is thus only limited by the thickness of the glass, metal or other substrate used.

Design flexibility

OLEDs offer superior patterning and homogeneity for individual shapes of signage. Illuminated pictograms, patterns or words can be predefined on the OLED substrate.



Transparency

OLEDs made on glass substrate can be transparent in the off state. This feature enables special lighting applications, e.g. windows or furniture with transparent or translucent elements.

Color quality

OLEDs emit a very soft and attractive light and the quality of the light comes very close to sunlight. To the human eye, the perception of colors is very high with this light source.

Color tunability

Based on a specific device structure of Novaled OLEDs and driving electronics it is possible to dynamically switch between white light shades and other colours.

Long lifetime

Current lighting sources require regular replacement cycles due to limited lifetime. The inherently long lifetime potential of standard Novaled OLEDs and the Novaled Liternity technology address this issue.

Energy efficiency

Lighting applications use around 20% of the world's electricity. OLEDs have the potential to be more efficient than current energy saving light bulbs. Novaled OLEDs can be up to three times more efficient than conventional OLEDs.

Clean technology

OLEDs will also make a significant contribution to sustainability due to their environmentally friendly materials and reduced packaging requirements.

The beauty of OLED light: Novaled Lighting Technology

Novaled technology delivers high quality OLED light, long device lifetime and low power consumption.

A new light source emerges

OLED combines energy efficiency with a very natural and pleasing light. The white light of Novaled OLEDs reaches a Colour Rendering Index (CRI) of up to 95 so the accuracy of perceived object colours comes very close to that experienced under sunlight. The classic incandescent light bulb fulfilled that need, but its very low energy efficiency has led to its progressive banning in many countries. Neither fluorescent tubes, compact fluorescent bulbs or inorganic LEDs can deliver light spectra similar to that of the sun.

Reasons for outstanding light quality of OLED

- entire visible light spectrum can be covered without any sharp peaks
- specific Novaled device architecture allows for almost any shade of white
- OLED white light is located slightly underneath the black body curve in the CIE diagram
- OLEDs can attain high CRI values
- no “green dip” such as inorganic LEDs suffer from

The Novaled technology enables daylight-like OLEDs with a long lifetime and very low power consumption which can be as low as 1/3rd of the consumption of standard OLEDs. These properties make Novaled OLEDs highly appealing for the lighting industry and qualified the Novaled PIN OLED® technology to play a key role in leading European OLED lighting projects like OLLA and OLED100.

A new world of lighting

The lighting industry is on the cusp of a revolution with OLED lighting technology. This unique area light source has an immense potential for entirely new applications in various industry segments.

With these devices a variety of futuristic luminaires, artistic light sculptures and signage can be brought to life. OLED is not limited to being just a source of light but also functions as furniture elements such as mirrors and surfaces or parts of interiors, rooms, buildings and more.

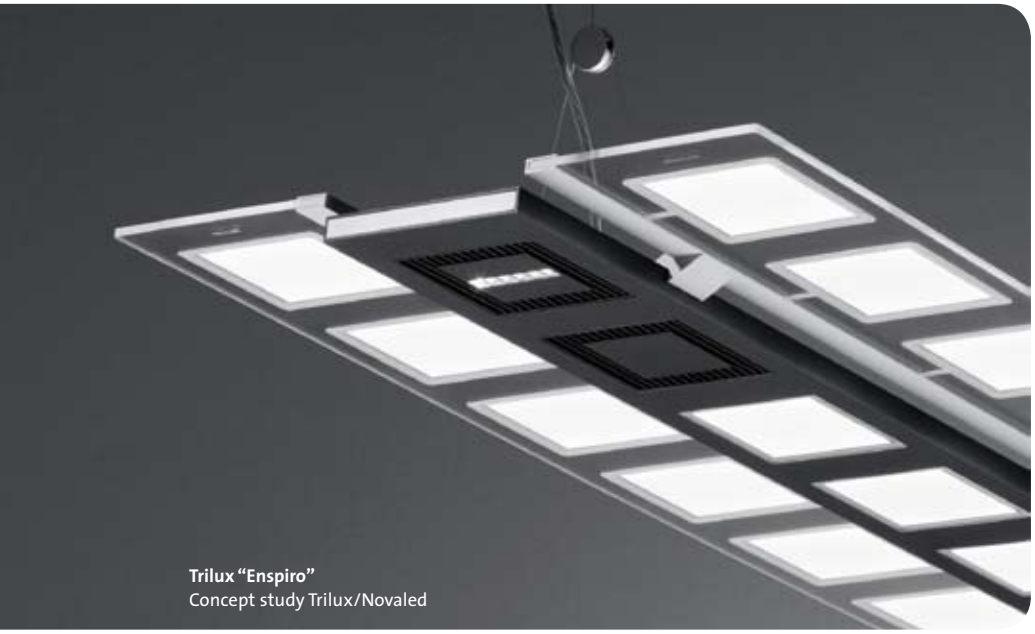
OLED Exit Sign
Willing/Novaled

As a light source and design element OLED fit perfectly in:

- Design Light: Luminaire, Fitting & furnishing
- General Light: Luminaire, Fitting & furnishing
- Appliance: White Goods, Controls, Signage
- Industrial: PDT, Machine vision
- Transport: Aerospace, Automobile
- Construction and Smart surface:
  Interior (Window, Wall, Mirror), Façade, other

Together with partner companies, Novaled did first concept studies on OLED lighting applications:

"Victory"
Novaled/Wolfram Design



Trilux "Enspiro"
Concept study Trilux/Novaled

Fasten Seat Belts Sign
Airbus/Novaled

Applications with OLED

Novaled offers customized OLEDs on glass in different sizes and colors and in addition can process OLEDs on metal substrates such as steel or aluminium.

Partition wall
Novaled

"Palm frond"
Novaled/Wolfram Design

OLED parking light
Novaled/Magneti Marelli

"4 x 4 is 34"
Ingo Maurer/Novaled

OLEDs on metal can provide additional value:

Easy integration of OLEDs in modules or systems
- Direct soldering onto the substrate
- Connector options like magnetic clipping

Thermal management
- Metal substrate is a much better thermal conductor than glass
- Increased lifetime and more homogeneous light emission under temperature stress

Bill of materials
- Substrate can function as one of the OLED electrodes
- More robust and less need of support framing

Design freedom
- Appealing and highly reflective off state appearance
- Bended applications will be possible in future

The OLED Lighting User's Manual

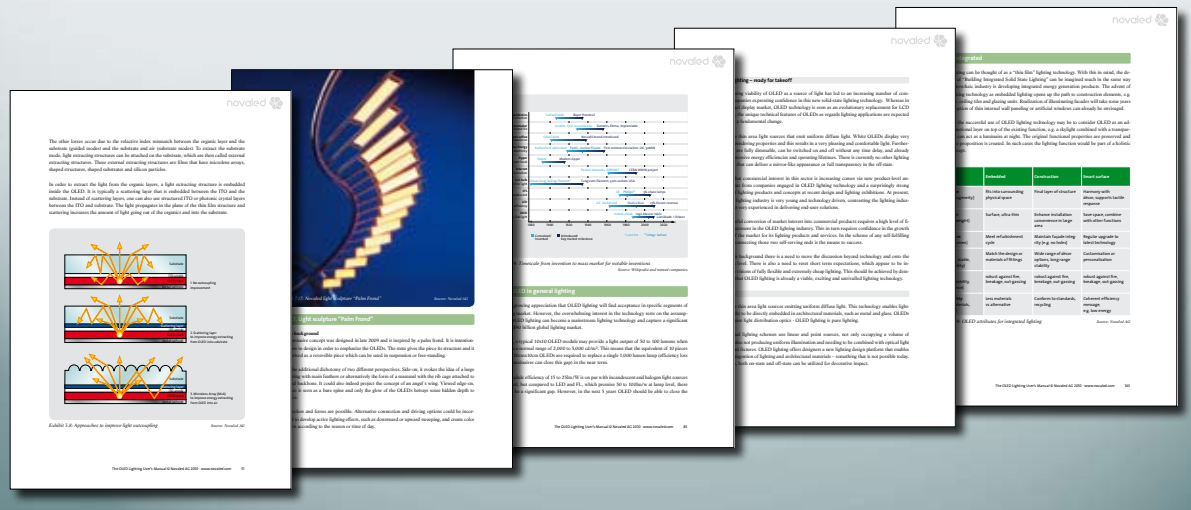
Technology, market and practical insights for all involved in the lighting business

All you want to know about OLEDs – the OLED Lighting User's Manual provides in-depth coverage of technological, marketing and practical aspects related to OLED lighting. It describes and positions the state-of-the-art technologies for organic and inorganic lighting to facilitate the appreciation of the OLEDs' unique selling points.
It brings a revolutionary perspective on the lighting market and its value chain to support a wide range of business considerations.
The Manual also describes novel case studies to help the reader understanding what it takes to make an OLED luminaire. This is a complete guide to OLED lighting.

The objectives of this OLED lighting report is to:

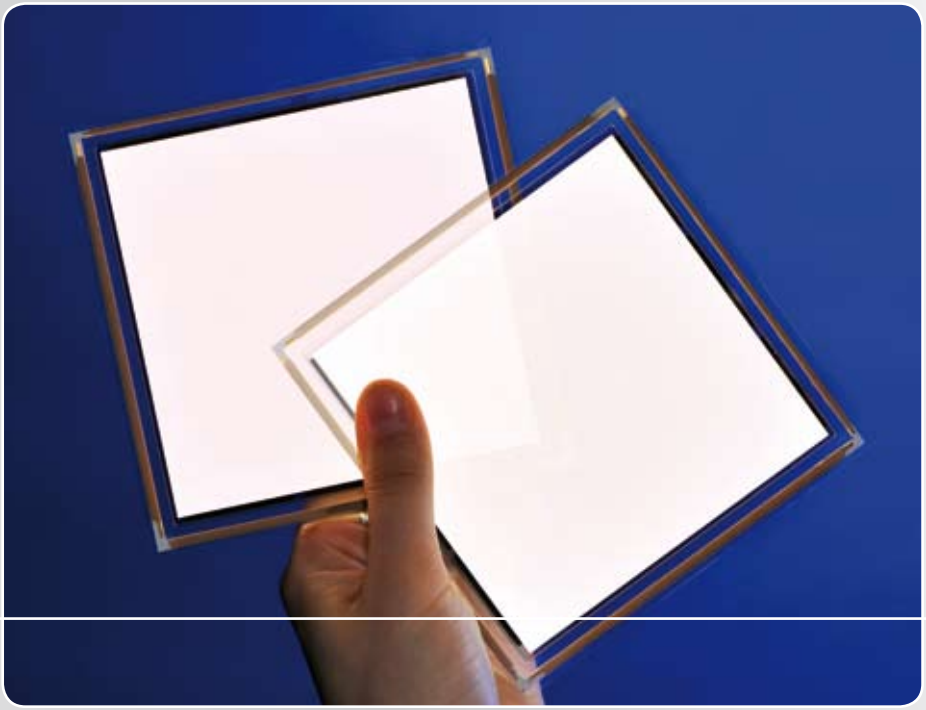
- **provide** a reference point for OLED outsiders and lighting experts wondering why and when they should engage into OLED for lighting
- **help** the reader to appreciate the USPs and challenges of OLEDs at various application levels
- **offer** the basis to model a possible OLED lighting business plan: from technology to market to product levels

"ZigZag"
Novaled/Wolfram Design



Content overview
OLED Lighting User's Manual

EFQM
Recognised for excellence
5 star



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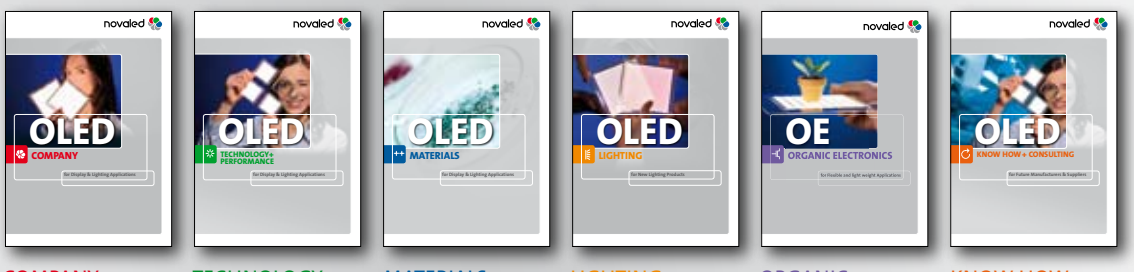

COMPANY | TECHNOLOGY+ PERFORMANCE | MATERIALS | LIGHTING | ORGANIC ELECTRONICS | KNOW HOW +CONSULTING

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Novaled AG is a world leading company in the OLED field specialized in high efficiency long lifetime OLEDs and an expert in synthetic and analytical chemistry. The company offers its Novaled PIN OLED® technology along with its proprietary OLED materials as well as R&D contracting, manufacturing of customized OLEDs and further services. Novaled has a strong IP position in OLED technology based on more than 400 patents granted or pending.

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