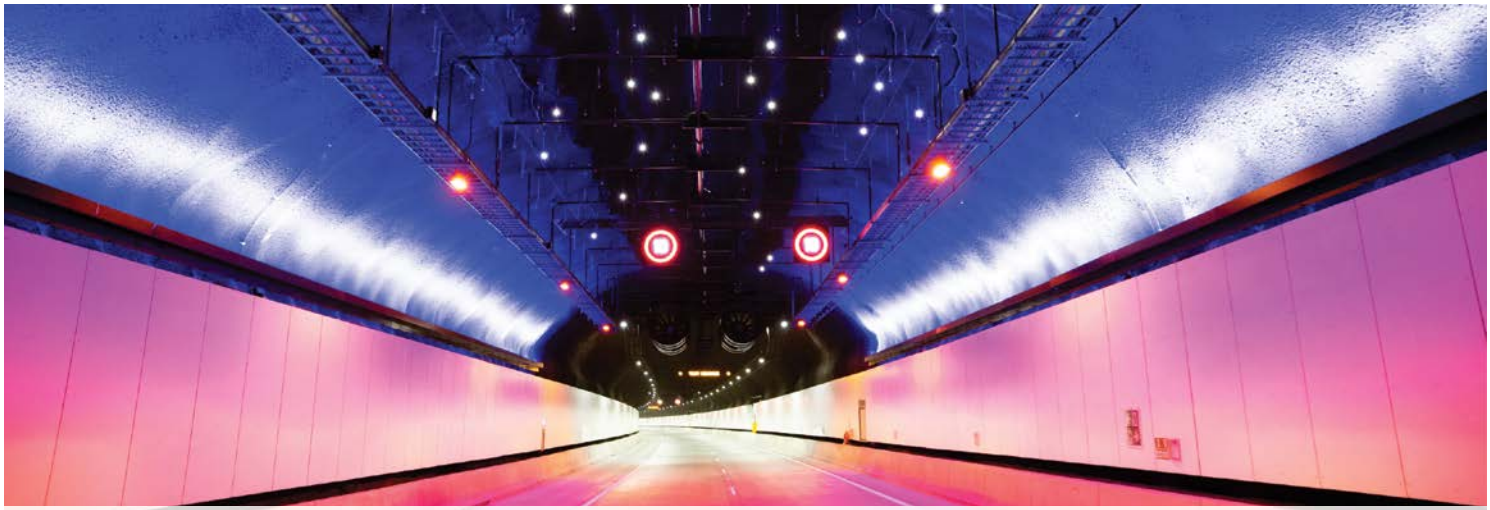
Industry: Transportation

Customer case study



Intelligent lighting solution for Australia's deepest road tunnel

Energy-efficient, cost-saving, and safe

Highlights

- Large cities mean a lot of traffic and increased demands on the safety of drivers and passers-by
- Bypass tunnels bring relief to highly frequented roads, but safety is always critical
- The Australian North-Connex Tunnel relies on a lighting solution from Schréder and Phoenix Contact

> "Intelligent lighting solutions gently introduce users to the differences in brightness when entering or exiting the tunnel."

Customer profile

When people hear "Australia," many automatically think of Sydney with its opera house, the Harbour Bridge, and Bondi Beach, which is popular with surfers. Along with Melbourne, the metropolis is the continent's largest city, with a population of around five million. The Greater Sydney Region covers 4,775 square miles.

Sydney is not only the industrial, commercial, and financial center of Australia but is also considered one of the cities with the highest quality of life in the world. To keep it that way, the NorthConnex Tunnel was built and inaugurated on October 31, 2020.

Figure 1: Sensitive adjustment of the lighting conditions to the increasing darkness in the tunnel is already necessary at the entry point. *(Image source: Transurban/NorthConnex)*

Challenge: Adapting brightness for driver safety

The three billion Australian dollar project is the deepest road tunnel in Australia, running up to about 300 feet underground. The 5.5-mile NorthConnex twin-tunnel connects the M1 and M2 motorways north of Sydney. It relieves Pennant Hills Road, one of the most congested roads in the state of New South Wales with a daily traffic volume of around 100,000 cars.

Prior to the upgrade, around 37,000 vehicles per day drove through the structure. Now, vehicles longer than 42 feet and higher than 10 feet must use the toll tunnel. The structure has two tubes, each with two lanes and an emergency lane. Now, the tunnel handles about 42,000 vehicles, including 5,000 trucks, per day.

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For safety reasons, road users' eyes have to adapt to different lighting conditions when entering and exiting tunnels (Figure 1). Intelligent lighting solutions gently introduce users to the differences in brightness. The NorthConnex Tunnel will also feature five different installations on the walls to keep drivers' attention: three white or blue backlit forest silhouettes facing north, and a starry sky and speed lines facing south. For this design, NorthConnex received an award from the International Association of Lighting Designers Awards on June 25, 2021 (Figure 2).

Figure 2: Award-winning backlit forest silhouettes and starry skies further enhance driver awareness. *(Image source: Transurban/NorthConnex)*

Solution: Immediate detection of occurring problems

Schréder, Betacom, and Phoenix Contact partnered to create a unique lighting solution for the tunnel. Betacom, the system integrator, developed, delivered, and commissioned the solution consisting of more than 6,000 LED luminaires of the Omnistar and GL2 Compact product families. The luminaires are connected via 592 Driver Boxes from the Phoenix Contact Advanced Tunnel Control System (ATS). The boxes contain the LED drivers that control the luminaires. Schréder conducted a photometric analysis of the later tunnel lighting to determine the exact position of the luminaires and the Driver Boxes.

The Driver Boxes contain both the LED drivers and the Lumgate connection electronics. Lumgate technology allows a free selection of available LED drivers, so it can be used universally. In addition to the power lines, the Driver Boxes connect to the lighting control system via a bus system (Figure 3).

The connection also contributes to easy commissioning. Commissioning mode immediately detects any problem that occurs during installation. Once the Driver Box has established communication with the controller, it commissions itself. In this context, it runs through a sequence that dims LED lights from dark to light several times. Running the commissioning process smoothly ensures that the LED luminaires and the Driver Boxes are connected correctly.

Automatic addressing of all participants

A unique aspect: This complex system addresses the individual luminaires automatically, based on the position of the luminaire in the tunnel. The lighting configuration created in advance can be output directly to the luminaire by photometric analysis without the need for manual assignment.

With a maximum extension of about 60 miles, a total of up to 4320 LED luminaires can be automatically commissioned per ATS. The ATS is always supplied with a corresponding application program so that no additional work is required during installation. It records the ambient conditions of the tunnel with up to four luminance sensors (L20 meters). The sensors' values are measured and evaluated to determine an ideal lighting level for the entire tunnel.

The actual control of the Lumgate control electronics and the LED drivers is predefined in 50 different scenarios. In addition, the system stores 15 special scenarios for higher priority in specific situations, such as an emergency or a dangerous event. The specification of the maximum speed currently applicable within the tunnel also influences the required light intensity, so the controller takes this into account. The respective configuration file, which the controller reads in independently, forms the basis for the lighting control together with the other frame parameters. The actual control of the Lumgate is based on the 50 lighting scenes, which are imported directly from the photometric analysis. This ensures that the specifications of the tunnel operator or the legal guidelines are exactly fulfilled. In addition, the system only generates the amount of light actually needed, which has a positive effect on energy costs.

Figure 3: Control cabinet with the scalable control solution for configuring the complete tunnel lighting – and without programming effort. *(Image source: John Ortika)*

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Results: Constant light intensity over the entire service life

The lighting is actually the largest energy consumer within the tunnel, so it has strong savings potential. The LED luminaires are subject to a technically determined output power. Phoenix Contact, together with Schréder, has developed a solution here that provides a constant light intensity over the entire lifetime of the installation. Because of this, the system accounts for the cleaning intervals of the tunnel luminaires, as well as the losses caused by the age of the LEDs. These influencing factors result in several thousand parameters that are included in the control of the ATS and supplied to the system integrator in a predefined form. The final step is the connection of the ATS to the control system of the NorthConnex tunnel. Standardized protocols can be used for this purpose.

The measured power is compared with a reference curve recorded at the beginning of the luminaire's lifetime. This makes it possible to identify strong deviations, such as those caused by failed segments, and issue any necessary warnings.

Overall, the integration of ATS into the tunnel's main network proved straightforward. Schréder and Phoenix Contact technical experts from Belgium and Germany, in addition to staff from the local subsidiary, supported the commissioning. The ATS control system allows remote access via modem, making this support possible even during COVID-19 travel restrictions. The solution's high energy efficiency reduces operating costs over its lifetime. More importantly, it provides a high level of safety and situation-based, reliable lighting of the tunnel tubes (Figure 4).

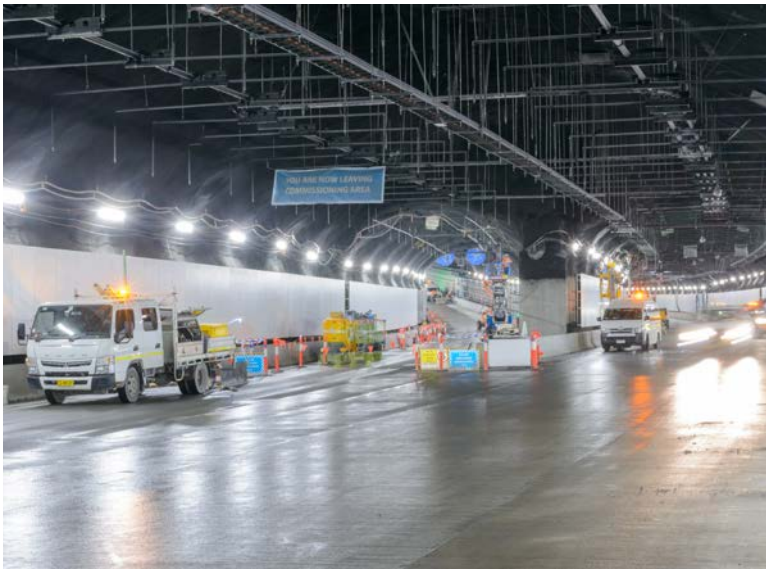

Figure 4: Schréder and Phoenix Contact technical experts from Belgium and Germany supported the commissioning despite COVID-19 travel restrictions, as the ATS control system allows remote access via modem. *(Image source: Transurban/NorthConnex)*

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