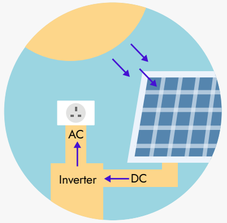
Photonics is Everywhere

Photonics is the science of creating, using, and modifying light. In this infographic we explore the ways that light is generated, harnessed, and manipulated in the objects and technology that shape our daily lives. From the simple to the complex, traditional to cutting-edge — we're highlighting the light, lasers, and energy in our homes.

Solar panels

Solar panels work by absorbing sunlight with photovoltaic (PV) cells made from layers of semiconducting materials. Each layer has different electronic properties that energise to create an electric field when hit by photons from sunlight.

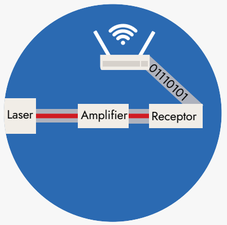
The panels convert these photons into direct current (DC) energy that travels to an inverter where it converts to alternating current (AC) energy that we use to power our lights, home appliances, and electronics.



Fibre optics for data and internet transmission

Lasers fire at rapid rates down single mode fibre cables connected to amplifiers that deliver light to receptors at the other end of the cable. The receptors interpret the light as data, and this data is sent to network-connected devices.

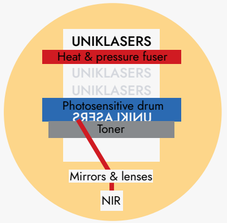
As of 2021, there are approximately 430 submarine cables with a combined length of 1.3 million kilometres. These submarine fibre optic cables transmit 99% of the world's internet data.



Laser printing

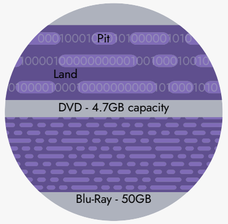
After clicking 'print', an image is communicated to the printer. Laser beams illuminate a photosensitive drum to form the image – where the exposed areas lose their electrical charge and toner powder affixes to the non-charged areas.

The drum is brought into contact with a transfer belt and a positive charge is applied from behind, transferring toner onto the belt. Heat and pressure are then applied as the toner is fixed to the paper.



DVD and Blu-Ray

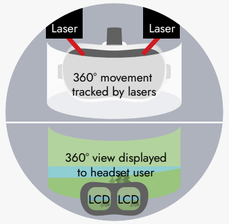
Optical data storage takes place in the form of 'pits' and 'lands' (grooves) on a disc surface that are read by a laser as the disc spins. The beam is reflected back when it hits the lands, and is scattered away by the pits. The transition between a pit and a land is interpreted as a '1' in binary. A greater density of grooves correspond to a greater density of storage capacity. DVD players use 650 nm red lasers to read discs, Blu-Ray players use near-UV blue-violet lasers at 405 nm and are backwards compatible in the sense that they can read lower capacity discs such as DVDs and CDs.

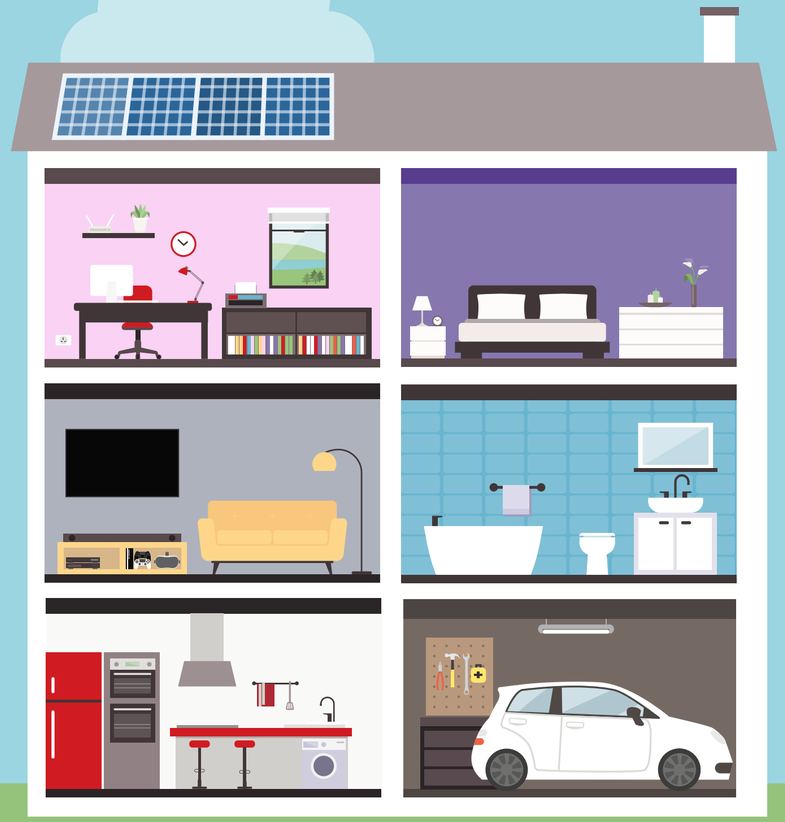


Virtual, Augumented, and Mixed Reality

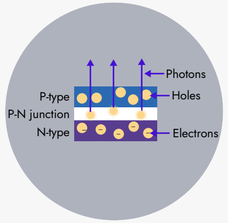
Current VR technology leverages photonics for immersive experiences through ultra-HD LCD screens and real-time motion tracking from external lasers that sweep 100x/second to track sensors on the headset and controllers.

Holographic lenses for AR/MR use RGB cameras, sensors, waveguides and laser projectors to illuminate digitally rendered holographic information and objects that appear to the user as visible in the real world.



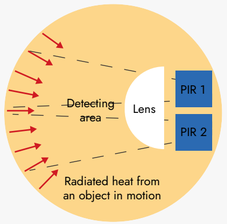


LEDs - light emitting diodes



A current through a semiconductor layer with extra electrons (N-Type) and a layer with extra holes (P-Type), allows electrons to flow across the junction. As the extra electrons move through the extra holes, they emit light. Semiconductor materials emit different wavelengths to create different colour LEDs. White light is created through a combination of colours, or through a phosphor coating on the diode. Low-power indicator LEDs are used in digital displays (microwaves, alarm clocks), fairy lights; while higher-power illuminator LEDs are used in lighting - floor and wall lamps, and ceiling lights.

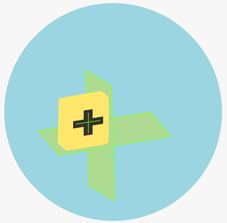
Home security



Passive infrared sensors have been the most traditionally used method for motion detection security devices. Deemed 'passive' as the sensors themselves do not emit heat or energy, PIR sensors detect infrared sources in a room and trigger an alarm when activated.

In modern camera-based security systems, 940 nm infrared LEDs illuminate a full room for night vision motion detection and video capture.

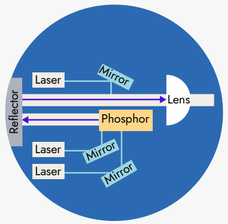
Laser levels



A laser level projects a constant level line, dot, or grid of light onto a surface on a horizontal and/or vertical plane. Laser levels for household use can help with creating a hands-free level reference for DIY measurements, finding parallel stud locations, accurately setting tiles, and hanging frames - for example.

Red lasers operating above 630 nm are commonly used for indoor levelling and positioning. Green lasers operating at 532 nm provide better visibility - especially for longer-range construction projects.

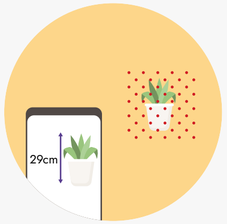
LED and laser headlights



Due to their long lifespan and high energy efficiency, LEDs are used in a variety of components in cars. Indicator dashboard lights, interior brake, fog, and headlights all use LEDs. Entering the automotive market are laser head-lights offering 2x the energy efficiency of LED lights as well as greater visibility.

Blue light lasers emitting a wavelength between 360 - 420 nm are beamed into yellow phosphor, creating a wide beam of white light that is reflected out onto the road during night-time driving.

LiDAR - light detection and ranging



In smartphones, solid-state LiDAR sensors create pulsed grids of infrared dots, with the distance to each dot measured individually, to map out the surrounding space and the objects in it. This allows for accurate dimensional measuring, object scanning for digital replication, and the virtual placement of objects for augmented reality shopping and gaming.
In cars, LiDAR is used for advanced driver assistance systems such as objection detection for collision prevention. Future applications will see LiDAR in autonomous vehicles.

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