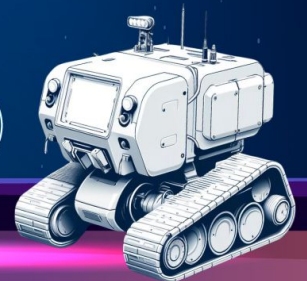


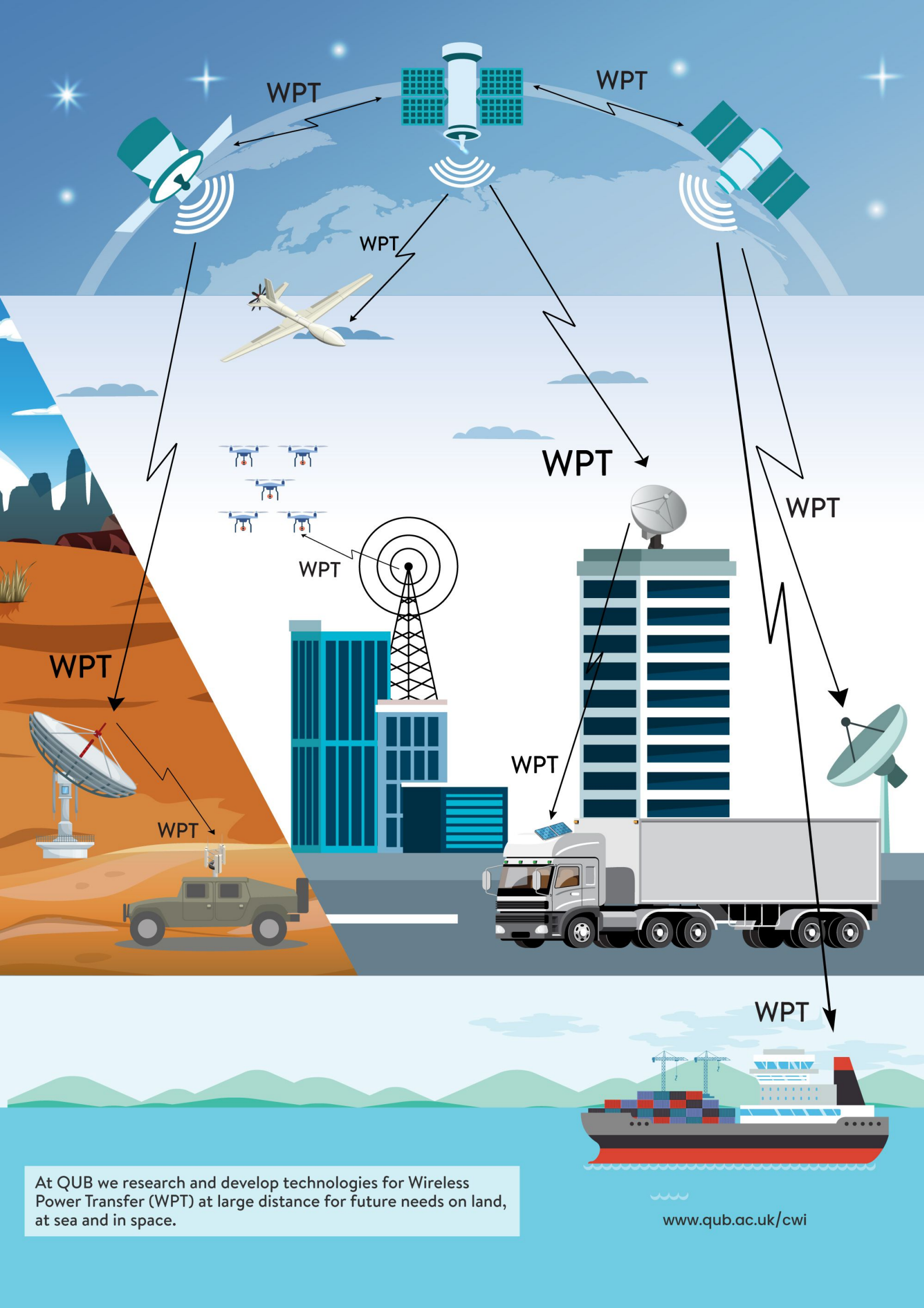
**QUEEN'S UNIVERSITY BELFAST**  
SCHOOL OF ELECTRONICS, ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

**CSIT** CENTRE FOR SECURE INFORMATION TECHNOLOGIES

**CWI** CENTRE FOR WIRELESS INNOVATION

# PIONEERING RESEARCH IN WIRELESS POWER TRANSFER (WPT)





At QUB we research and develop technologies for Wireless Power Transfer (WPT) at large distance for future needs on land, at sea and in space.

[www.qub.ac.uk/cwi](http://www.qub.ac.uk/cwi)

**Wireless power transfer (WPT) is the transmission of electrical energy without the use of wires. It works by using electromagnetic fields to transfer energy between a power source and a receiver device. WPT is becoming increasingly important as it enables convenient, cable-free charging and powering of a wide range of devices in civilian and military applications, while reducing the need for physical connectors and power cords.**

**Wireless powering will be needed for next generation electric vehicles (from cars to ships and drones), biomedical implants and sensors, robots, industrial equipment and instrumentation, and satellites within constellations.**



## WPT INNOVATION

Our team of experts in power amplification, antenna design, and beamforming have researched since 2018 the fundamental requirements to develop a practical demonstration of a system that can transfer power to an object or objects at large distance whose position relative to the wireless power source is unknown a-priori, and that can lie in either the near-field or the far-field of each other, with arbitrary orientation in both line of sight and beyond visual line of sight (BVLOS) situations.

Our researchers have produced two major innovations for BVLOS WPT: beyond near/far field auto-focusing antenna array technology, and orientation-agnostic rectifying antenna systems. Our know-how can be applied to bring energy remotely (in free space) to any context.



## WPT SYSTEM DESIGN

Our state-of-art design of an end-to-end WPT system consists of the following electromagnetic elements:

- **Rectifying Antenna (Rectenna)**

We have designed and fabricated a 144-element rectenna capable of receiving up to 1W per element, thus allowing 144W of total harvested power. One of the big advantages of our rectenna is its simplicity and low cost.

- **Transmit Array Antenna**

We custom designed a thinned array of 27 helical antennas that uses a sophisticated phase conjugating circuit that includes a 10W power amplifier with 84% efficiency.

- **n-Elements Helical Antenna Array**

We built and measured a 6-element array for practical validation. The results showed that our array could retrodirectively steer the beam over a  $\pm 40^\circ$  range, which will be very valuable for the application of remotely powering a moving drone.

## THE FUTURE OF WPT

We are contributing to the ambitious UK Cassie space-based solar power project, in collaboration with Space Solar Ltd, to produce a 360° beam steerable retrodirective demonstration for transmitting solar energy from space via a microwave beam. We see this as a very high impact project and an excellent application of our current WPT technology.

We will also commence work on power beam security, applying principles of Space Security that we are currently developing in-house.

The results of our EPSRC-funded WPT project (2018-2023) puts our research team in an ideal position within the UK and the world to tackle many emerging applications of WPT on Earth, the Moon, and Mars. Our vast experience in WPT electromagnetic design gives us a significant head start in this fast-growing domain.

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