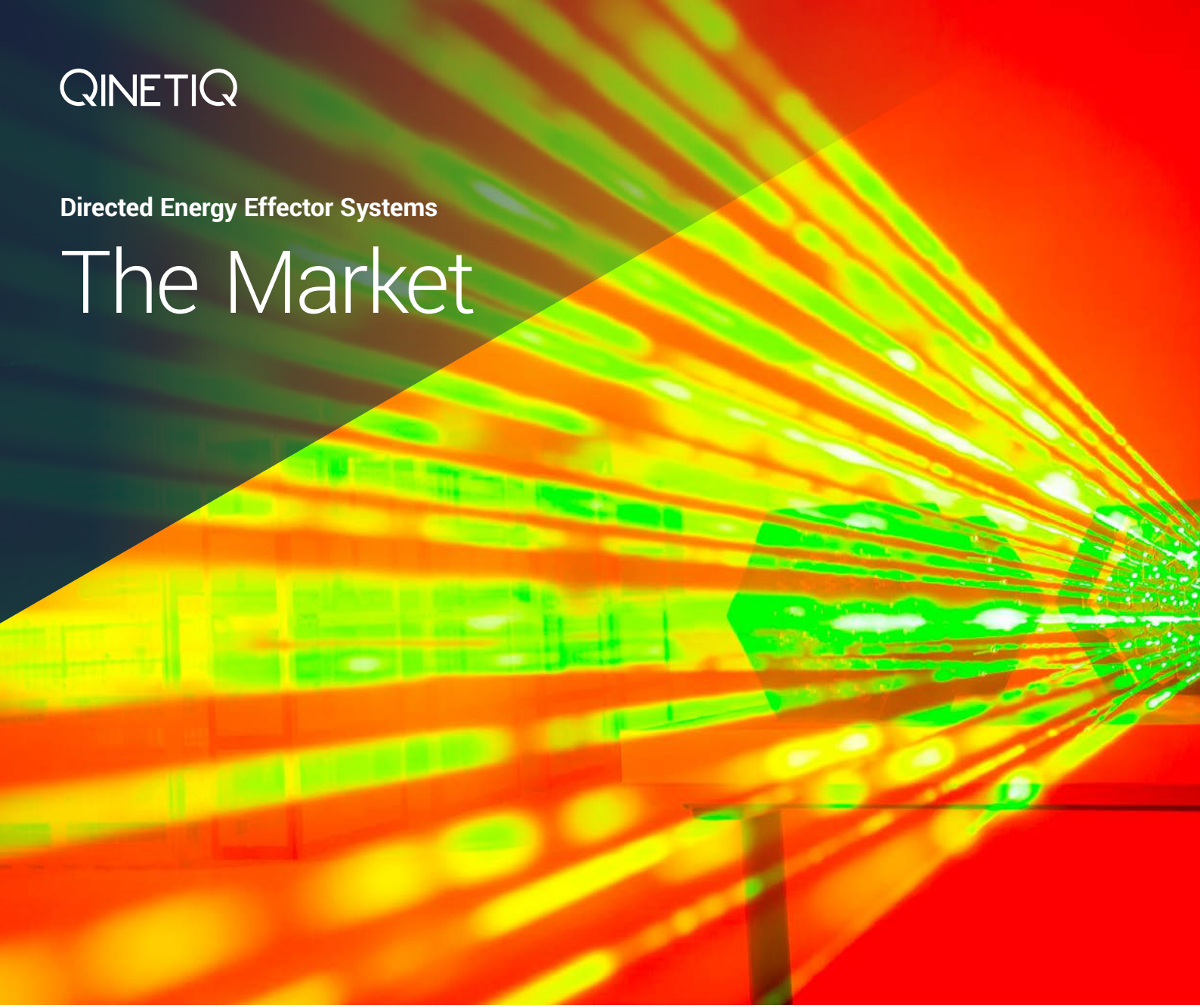
QINETIQ

Directed Energy Effector Systems

The Market



The Directed Energy effector market is in its infancy but is set to grow

Various published assessments of the market size and potential for Directed Energy (DE) exist, all of them predict a significant rise in DE budgets worldwide. Predictions worldwide range between 80 to 100 Billion USD by 2030 and the US, as is often the case, dominates the predicted investment portfolio. In the UK funding for DE Science and Technology (S&T) has been modest and has wavered yet the UK still has some vital Intellectual Property.

Market size predictions should be treated with extreme caution. Market assessment assumes that DE has proven its military value and will naturally be selected into one of several applications.

DE Systems are very much still in the maturation phase of their development and have yet to cross the infamous “Valley of Death” between S&T and military utility.

In the UK there is no acquisition plan (equivalent to the US Programme of Record) for a DE system.

Also, DE should not be thought of in such simplistic terms of conventional defence acquisition. The cost recovery model for traditional weapon systems is based on the logic that expensive R&D activity, which is often co-funded by industry, is recovered from sales of Weapons stocks that have a finite lifetime. DE has to been seen in the context of a much more agile acquisition process where there is an initial purchase of a sub-performance system and iteration over time to full capability. The optimum procurement model has perhaps more in common with the purchase of a smartphone which is upgraded and improved by the user over time.

The HELIOS programme for the US Navy is an example here. The first stages of the acquisition include fairly low power lasers which will have dazzle capability and an agile upgrade path to 60kW class laser and beyond.

Market Segments or leading applications for High Energy Laser (HEL) effector systems, for now, are included in the list below.

These are broadly aligned with the maturity of the application:

- Ship based missile defence, particularly anti-ship cruise missile defence
- Countering UAVs, Unmanned Surface Vessels (USVs) and possibly Unmanned Ground Vehicles (UGVs)
- Countering Fast Attack Craft
- Ground Based Air Defence as part of a V-SHORAD capability enhancement
- Manned and Unmanned Vehicle self defence
- Strike applications from combat aircraft or attack class helicopters
- Future missile defence including, Hypersonic missile defence
- Anti-Satellite applications

In addition to these there are other nascent defence, dual use and civilian applications such as; point to point very high data rate transfer and communications; LIDAR; Industrial processing and wireless power transfer.

The Global market picture

The US dominates the world in its budget allocation for DE and for the moment the US strategy of 'buying American' is still very much in play. However, as several visits to the UK by high ranking US military officials have testified the US is particularly interested in the UK DragonFire concept and very particularly in our HEL coherent beam combining technology.

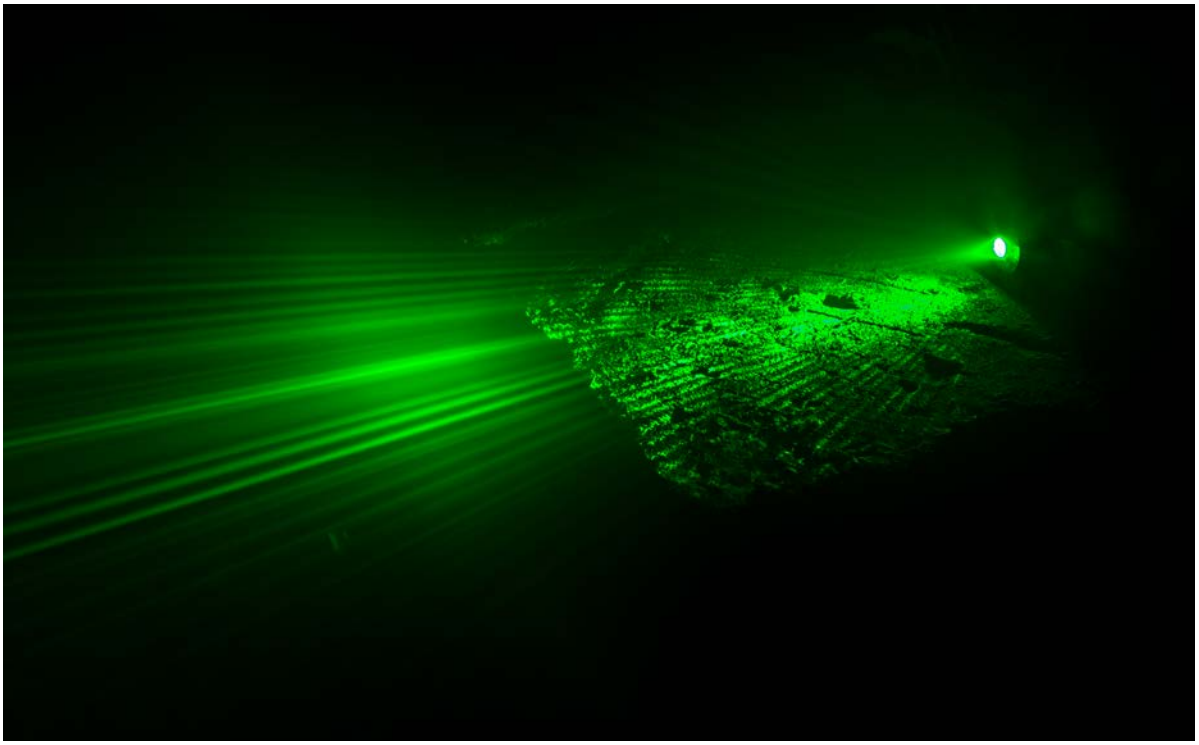
We assess that most of the frontrunner US HEL programmes do not use this technology and that they are several years behind UK developments. That said we are concerned that the US, with its industrial and academic capacity, will catch up fast.

The Middle East is at the forefront of experiencing UAV attacks as exemplified by the UAV or drone strikes on two key oil installations in Saudi Arabia in 2019.

Australia in particular is of interest now. The Australian DoD's Defence Science and Technology (DST) Group has very recently established a Science and Technology Network in Directed Energy Technologies and Systems. QinetiQ has presence and capability in Australia and is actively pursuing DE development opportunities there including a multi-year project to develop a coherently combined HEL effector operating at a different wavelength to the UK LDEW CDP. QinetiQ UK and QinetiQ Australia are jointly pursing exciting opportunities in Australia.

Countries on the European continent, Japan and the wider Asia-Pacific region have interest in DE at varying levels of aspiration and urgency. South Korea is actively exploring LDEW for maritime self-defence and Taiwan and India have published proposals to acquire low power HEL effectors in the near term. For the UK and for QinetiQ access to Defence budgets in these countries is more challenging.

There is no doubt that the business proposition for investment in DE is compelling. Perhaps of most interest to Defence planners is the fact that DE technology, like other revolutionary technologies such as Robotics and Autonomous Systems will force Defence acquisition to work in a much more agile way.



Next Steps

Securing UK Intellectual property and maintaining freedom of action requires advancement of DE Technology on several fronts

The detailed discussion above leads us to several recommendations. We suggest that for the UK to advance DE technology, consideration should be given to several aspects and we have articulated this in terms of near term technology development goals and medium term UK capability enhancement and sustainment:

The near term (now to 2030)

Support must be provided for a multi-year plan for DE Innovation and maturation. This should consider DE effector technology i.e. the laser source, other vital sub-system technologies e.g. precision tracking and aim-point maintenance, protection technologies e.g. materials that are resistant to laser ablation and other lines of development e.g. training and simulation. In the recent past there have been pauses between programmes and this has hampered the establishment of strong industrial capability and a joined up academic base. The new MOD S&T Strategy appears to address this need.

Investing in game-changing HEL coherent beam combining technology. Investment is required to secure IP for the benefit of the UK and secure export opportunities, principally in Australia and the Middle East and to create leverage in the US. At present a competition driven approach is preferred over the intelligent backing of selected world leading technologies and this slows maturation of those technologies enabling other non-UK players to catch up. Also, details on DE are held at a relatively high level of security classification which tends to hinder UK industrial engagement in US opportunities.

Focussing efforts on enabling outdoor T&E of DE systems. Presently our immaturity of understanding of collateral risks posed by DE is hindering DE experimentation outdoors on Ranges in the UK and therefore slowing progress. Recent DE trials have required endorsement by the Secretary of State for Defence which is not a practical solution in the longer term.

It has been informally disclosed that the Navy would take a HEL effector on board but only if a standing approval to fire the Laser was in place and that safety concerns were fully addressed.

The medium term (2025 and beyond)

Support for UK manufacturing industry. This is needed to provide a strong indigenous supply chain for high power fibre laser amplifiers, special high performance optical coatings and optics technologies. Presently QinetiQ has to source fibre laser amplifiers from non UK supply chain because the UK indigenous capability is not mature. This support could in part come from non-MOD initiatives such as the innovation catapults.

QinetiQ anticipates that a manufacturing partner that can demonstrate agility will be needed as the acquisition approach for DE will require rapid prototyping / manufacturing. The new MOD S&T Strategy appears to address the innovation and maturation need but industrialisation and prototype manufacturing also require investment.

The recommendations presented here are not particular to HEL technology but are equally relevant to other DE effector technologies such as HPRF, Ultra Intense lasers and particle beams. The focus on HEL should not be so bright as to diminish these other important effects.

It is also vitally important to consider the broader lines of development

- Advancing and improving sensor technologies to meet the demand posed by HEL effectiveness
- Platform and asset protection and resilience from adversarial use of DE
- Training and simulation to enable end users to understand the benefits and limitation of DE systems
- Development of novel procurement or acquisition approach within MOD to take advantage of the very agile capabilities that DE effectors can bring

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