

# GOOCH & HOUSEGO GENERAL PRESENTATION

JANUARY 2018

# ABOUT US

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## G&H is:

- **World class**
- **Worldwide**
- **World leading**

A manufacturer of photonics solutions that solve any optical challenge:

- **Lasers**
- **Lenses**
- **Light**

Our heritage, pedigree and people provide our customers with:

- **Flexibility**
- **Innovation**
- **Growth**

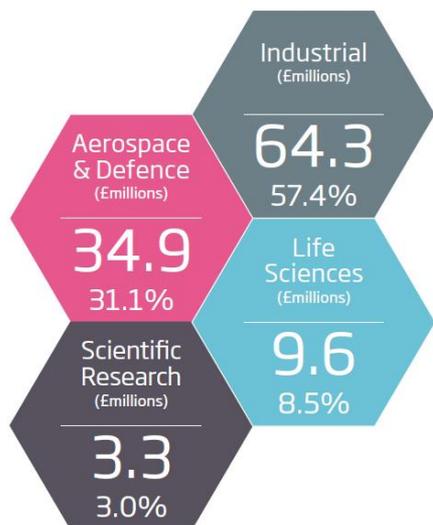
# FINANCIAL OVERVIEW

## Financial Track Record

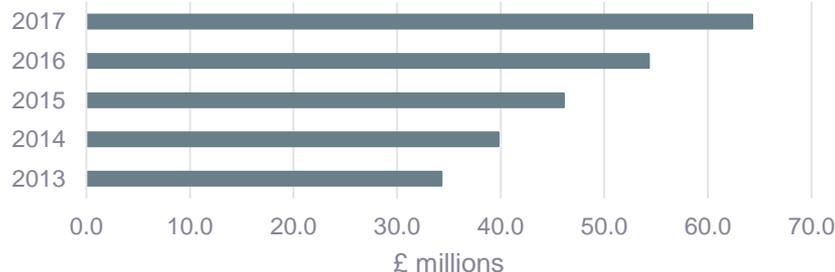
“G&H met its FY 2017 financial goals and was able to make strategically important investments in key skills, processes, systems and the latest capital equipment. Significant progress has been made towards meeting our strategic aims of diversifying the business and moving up the value chain.

Mark Webster, CEO **Industrial**

### Historical revenue by sector



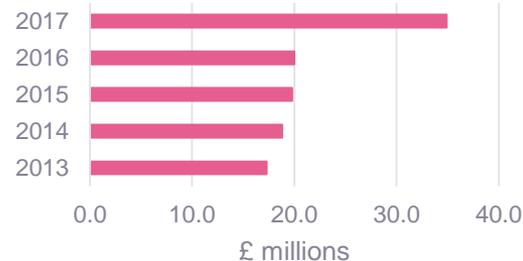
#### Industrial



#### Life Sciences



#### Aerospace & Defence



#### Scientific Research

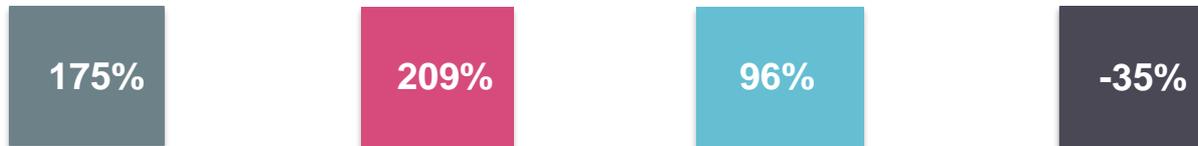


# GROWTH THROUGH DIVERSIFICATION

The newer markets of aerospace & defense and life sciences, together with new application areas within our Industrial market, offer the potential for significant growth through their rapid adoption of photonic technologies



## Seven Year CAGR By Market



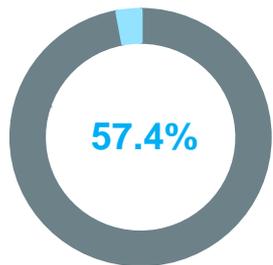
# TECHNOLOGY, PRODUCTS & MARKETS

## Industrial

Revenue:

**£64.3m**

(2016: £54.3m)

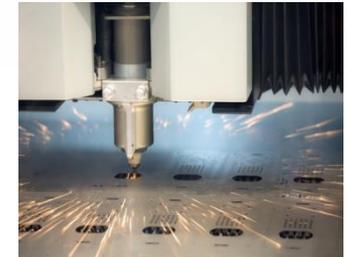


## Markets

- **Micro-electronics and light manufacturing**
- **Fiber optic sensing**
- **Telecommunications**
- **Metrology**

## Applications

- Fiber lasers
- Solid state lasers
- Semi-conductor equipment
- Inspection equipment
- Perimeter sensing
- Laser scanners
- Wind turbines
- Undersea amplifiers
- Specialist networks
- 40G and 100G Modulation systems
- Laser interferometers



## Growth strategy

- To continue to invest in R&D and process engineering, bring to the market new products and to remain at the cutting edge of technology in industrial photonics.
- To focus on niche markets that demand high levels of quality and reliability, typically require complex design and engineering input and for a number of our products require survivability in harsh environments.
- To continue to focus our energies and investment on making the transition from a components supplier to a manufacturer of sub-assemblies, instruments and systems, where appropriate

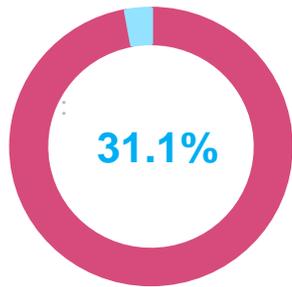
# TECHNOLOGY, PRODUCTS & MARKETS

## Aerospace & Defence

Revenue:

**£34.9 m**

(2016: £20 m)



## Markets

- Imaging
- Direct energy weapons
- Target designation and range finding
- Navigation systems
- Space photonics
- Countermeasures
- Periscopes and sighting systems

## Applications

- Aircraft platforms
- Missile systems
- Ring laser gyroscopes
- Fibre gyroscopes
- Telco satellites
- Space navigation
- Infrared countermeasures
- RF countermeasures
- Armoured fighting vehicles



## Growth strategy

- To continue to focus energy and investment on moving from being a components supplier to a sub-systems provider.
- To continue to invest in manufacturing processes and engineering in order to meet the exacting, and changing, expectations of this sector.

# TECHNOLOGY, PRODUCTS & MARKETS

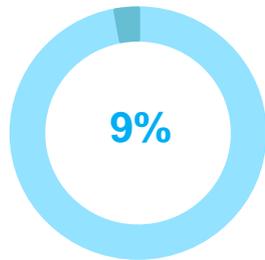
## Markets & Applications

### Life Sciences

Revenue:

**£9.6 m**

(2016: £7.9 m)

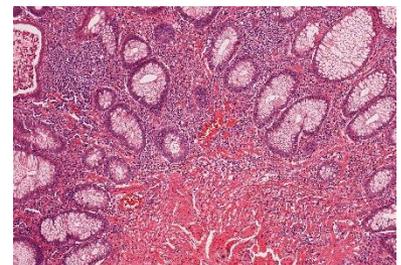


### Markets

- **Optical coherence tomography (OCT)**
- **Laser surgery**
- **Microscopy**

### Applications

- Ophthalmic imaging
- Cardiovascular diagnosis
- Prostate surgery
- Cosmetic surgery
- Tattoo removal
- Confocal microscopy
- Spectrometry



### Growth strategy

- To continue to invest in longer term R&D projects and to develop the existing portfolio of products, to ensure that they remain competitive.
- Where appropriate seek to sell the full range of our Life Sciences products to a wider range of customers.

# TECHNOLOGY, PRODUCTS & MARKETS

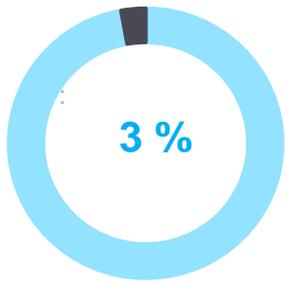
## Markets & Applications

### Scientific Research

Revenue:

**£3.3 m**

(2016: £3.9m)

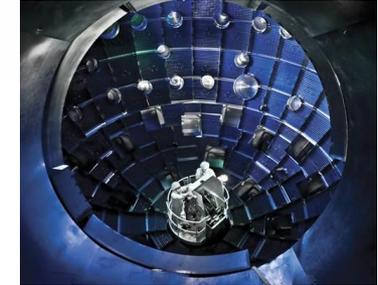


### Markets

- **Internal confinement fusion**
- **Scientific instrumentation**

### Applications

- National Ignition Facility (NIF)
- Laser Mega Joule
- Research institutes
- Universities



### Growth strategy

- To maintain and develop the business's capabilities in crystal growth and ultra-precision optics for nuclear fusion research and energy, university research and "Big Science" projects. Gooch & Housego is the custodian of some of the world's most advanced optical technologies.

# ACQUISITIONS

## Strategic acquisition activity in 2017

Strategic acquisitions remain an important part of G&H's business model and in February 2017 we acquired StingRay Optics LLC.

StingRay is a USA based specialist designer and manufacturer of high performance optical and opto-mechanical sub systems for demanding defence and commercial applications.

Their product range is focused on laboratory, ground based, airborne, unmanned aerial vehicles ("UAVs") and space applications for key US defence customers. Their addition to the G&H Group strengthens our position in the US A&D markets through the combination of our infrared coating and their opto-mechanical design capabilities.



# OUR STRATEGY

**Remains one of diversification and moving up the value chain**

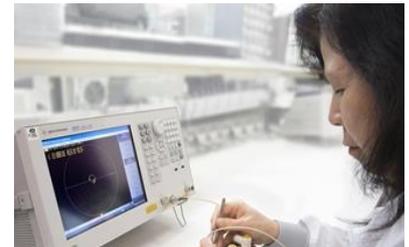
## Diversify

Exploit high-growth opportunities for photonics technology across multiple sectors to provide balance and reduce cyclicity. FY2017 demonstrated the value of this policy and the resilience that is built into the business.

**Establish critical mass in the A&D and Life Sciences sectors through a combination of investment in R&D and further acquisitions.**

## Targeted High Growth areas include:

- Fiber optic lasers
- Fiber optic sensing
- Precision inspection equipment for microelectronic manufacturing
- Laser surgery
- A&D sub-systems
- OCT medical diagnostics
- Space satellite communications

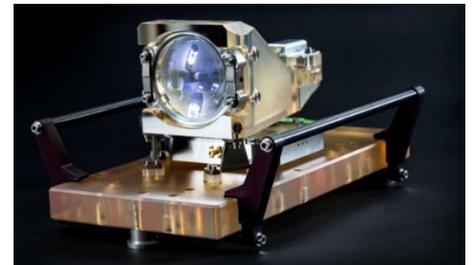


# OUR STRATEGY

**Remains one of diversification and moving up the value chain**

## Moving up the value chain

- Leverage excellence in components to become a solutions provider.
- Transitioning from component supplier to critical partner.
- Over 30 engineers and scientists in the Systems Technology Group (STG), providing the electronic, software and mechanical engineering expertise required for systems development.
- Most notable successes in space satellite communications and optical coherence tomography (OCT).

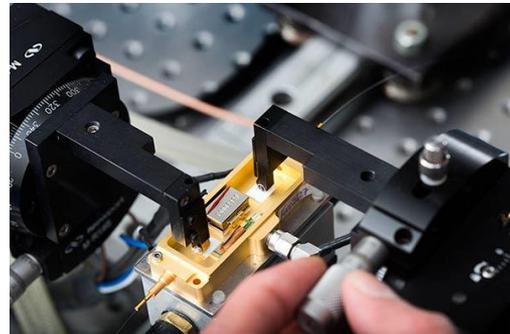


# PRODUCT CAPABILITIES



## 4 UK Facilities:

- Ilminster (acousto optics and precision optics)
- Torquay (passive fiber optics, modules, and photonic packaging)
- Glenrothes (precision optics)
- Kent Periscopes (electro-optic sighting systems)



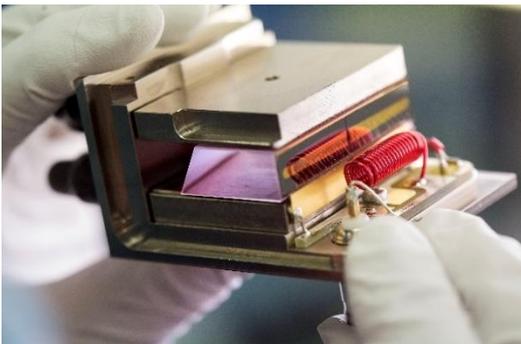
## 7 US Facilities:

- Cleveland (electro optics, non-linear optics, and precision optics)
- Palo Alto (acousto optics and RF Modules)
- Boston and Madison (active fiber optics, modules, and photonic packaging)
- Moorpark (precision optics)
- Orlando (light measurement instrumentation and calibration services)
- StingRay Optics (lens assemblies for imaging across the infrared spectrum)



# ACOUSTO-OPTICS

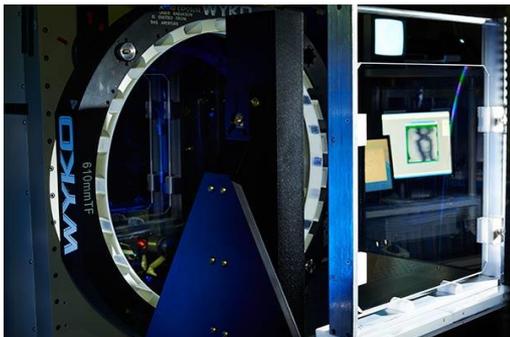
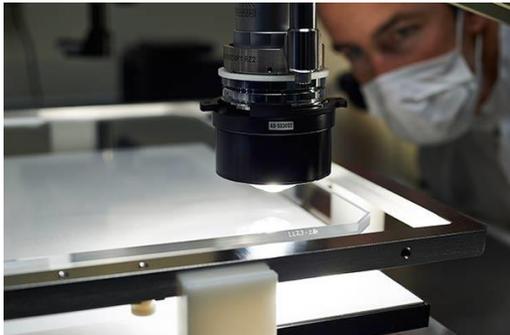
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**Two facilities (one in the US and one in the UK) making a range of AO products:**

- Intra-cavity modulators: Q-switches, mode-lockers & cavity dumpers
- Other modulators: Pulse pickers, beam deflectors, frequency shifters & tunable filters.
- A range of RF drivers designed to work with the AO devices described above.

# NON-LINEAR CRYSTAL OPTICS



G&H has a crystal growth facility in the USA, which grows:

- Optical Lithium Niobate for telecom applications
- PPLN (Periodic Poled Lithium Niobate)
- Lithium Tantalate
- KDP
- KD\*P
- TeO<sub>2</sub>
- BBO

# ELECTRO-OPTICS



From a base in Cleveland, Ohio, G&H manufacture a range of EO devices for Q-switching, pulse-picking and cavity dumping applications.

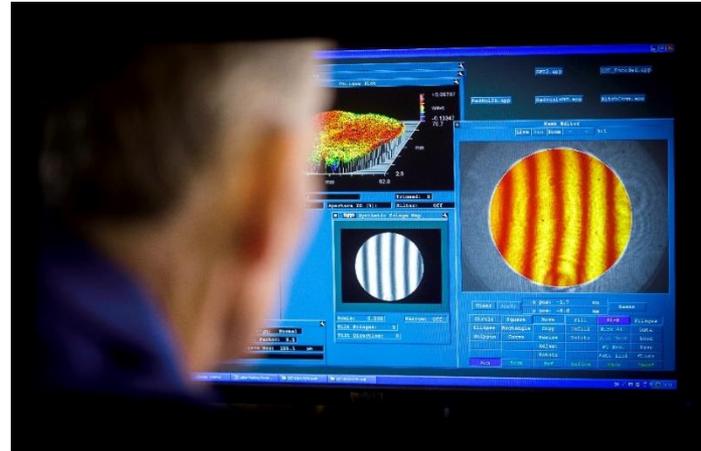
Offering faster switching speeds than AO devices, with higher average power handling. They offer a larger aperture and are typically used in scientific and medical applications, plus high gain material processing lasers.

We grow our own KDP, KD\*P and BBO crystals and so are in a unique position of controlling all parts of the manufacturing process in a single facility

# PRECISION OPTICS

With four facilities in the US and UK, G&H offers a truly unique range of manufacturing capabilities

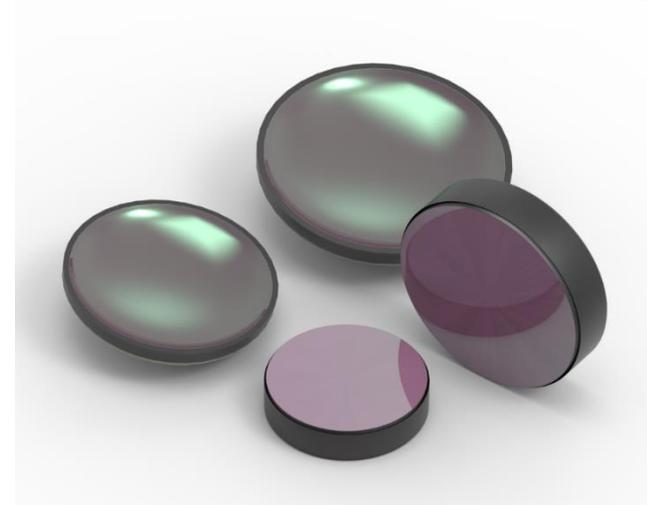
- Crystal growth: BBO, CdS, CdSe, KDP, KD\*P, LiNbO<sub>3</sub>, TeO<sub>2</sub>
- Single point diamond turning of aspheric optics
- Magnetorheological finishing (MRF)
- Superpolishing
- Thin film coating including AR, broadband, dielectric, high-reflection, metallic, V-coats and double-V coats
- Adhesive-free bonding
- Opto-mechanical assemblies
- World class metrology systems



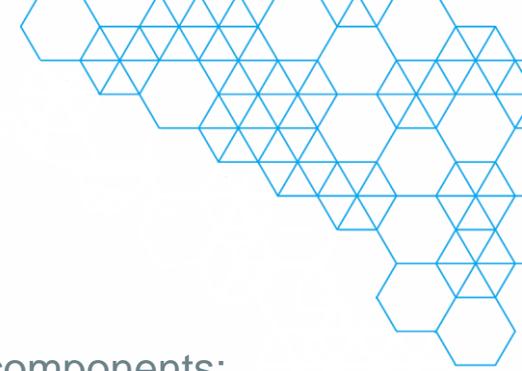
# PRECISION OPTICS

Fully customized optics for imaging, laser and sensing applications in industry, aerospace & defense, life sciences and scientific research

- Domes
- Infrared lens assemblies
- Infrared optics
- Lenses aspherical, spherical, cylindrical, diffractive and hybrid
- Mirrors
- Optical domes
- Opto-mechanical assemblies
- Prisms and cubes
- Ring laser gyroscope components
- Superpolished optics
- SWIR lens assemblies
- Telecom optics
- Wave plates – UV-IR
- Windows and flats



# FIBER OPTICS (PASSIVE AND ACTIVE)



## Three facilities (USA & UK)

Fused fiber optical branching components:

- Wavelength combining
- Power combining
- Tap coupler/splitter
- Photonic packaging capability
- Fiber coupled sources
- Fiber coupler detectors
- Fiber Optic module capabilities
- Interferometers
- Amplifiers





ENABLING PHOTONIC TECHNOLOGIES

Precision at the heart of everything we do

We are experts in the science behind photonics technology, its application and commercial development.

**We are Gooch & Housego.**