SPEAR
INVEST

TOP THEMES IN INDUSTRIAL TEHCHNOLOGY

Diving deep into opportunities across the industrial supply chain

November 2021

INVESTMENT THEMES

Established themes with significant market cap and meaningful runway ahead

ENVIRONMENTAL FOCUS AND DECARBONIZATION

MANUFACTURING DIGITALIZATION

ROBOTICS AND AUTOMATION

Emerging themes with limited market cap today, but sizable future potential

ARTIFICIAL INTELLIGENCE

PHOTONICS AND ADDITIVE MANUFACTURING

SPACE EXPLORATION

ENVIRONMENTAL FOCUS AND DECARBONIZATION

TREND

Industrials, Transportation, and Building Operations account for >90% of global greenhouse emissions.

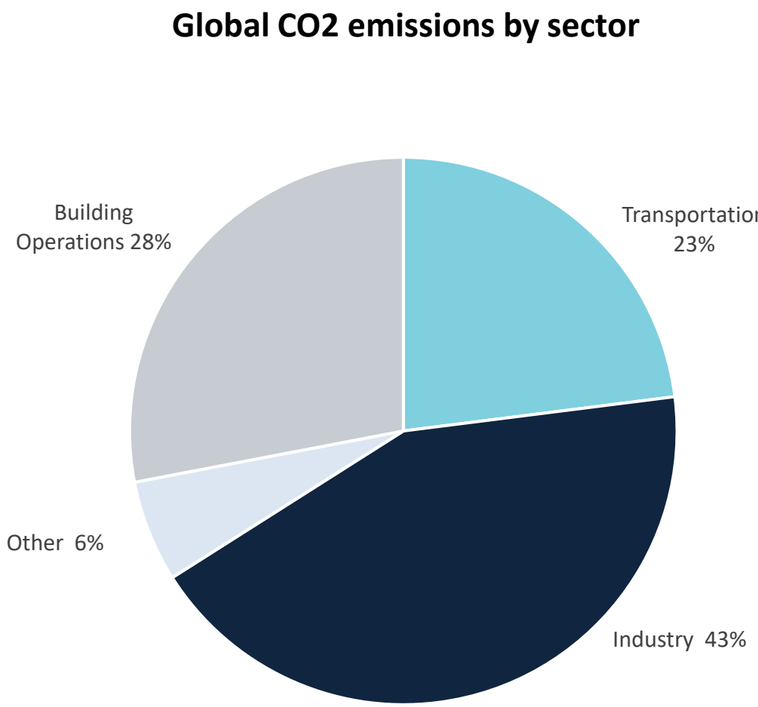
ESG is becoming a top priority for companies and investors creating several high growth markets and attractive investment opportunities.

INVESTMENT UNIVERSE

We invest in companies that develop products that use alternative fuels and energy sources (such as electricity, hydrogen) and the entire supply chains around them e.g., from the mine to the charging station.

We identify technologies that reduce emissions (e.g., carbon capture), and provide energy efficient equipment and solutions (e.g., compressors, blowers, HVAC systems, HPWH water heaters etc.).

Opportunities in every sector and across many supply chains



* Industry includes mining and materials
Source: IEA, SPEAR Invest

Transportation (23% of global CO2 emissions):

- **Electrical grid equipment** – including medium and low voltage
- **Lithium** – a bottleneck in EV production – by 2025 there will not be enough lithium to meet demand targets
- **New materials:** e.g., GaN powered transistors replacing silicone

Industry (43% of global CO2 emissions):

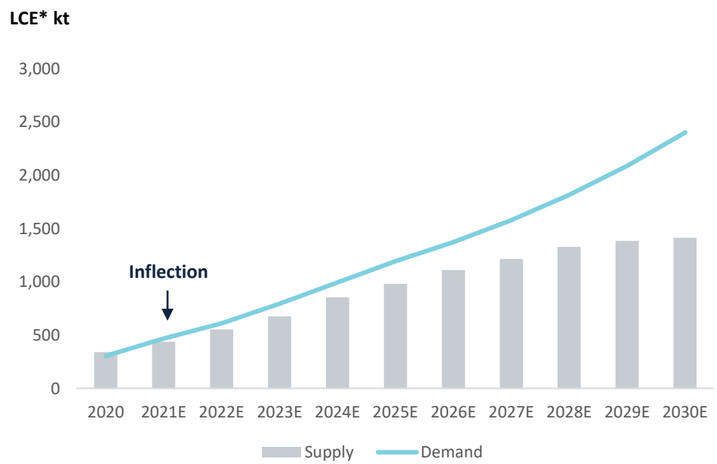
- Energy efficient equipment (e.g., **compressors, blowers**, etc.) can reduce energy consumption by 10%+

Buildings (28% of global CO2 emissions):

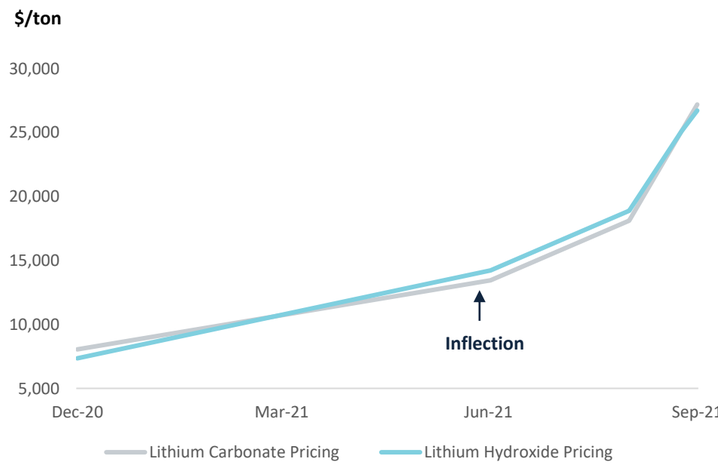
- **Smart connected buildings** can reduce operating costs by 30%
- **Roofing and insulation** materials can significantly reduce heating consumption (# 1 source of residential energy use)
- HPWH **water heaters** can generate significant savings (#2 source of residential energy use and emissions)

Example: lithium mining is a bottleneck in meeting EV production targets

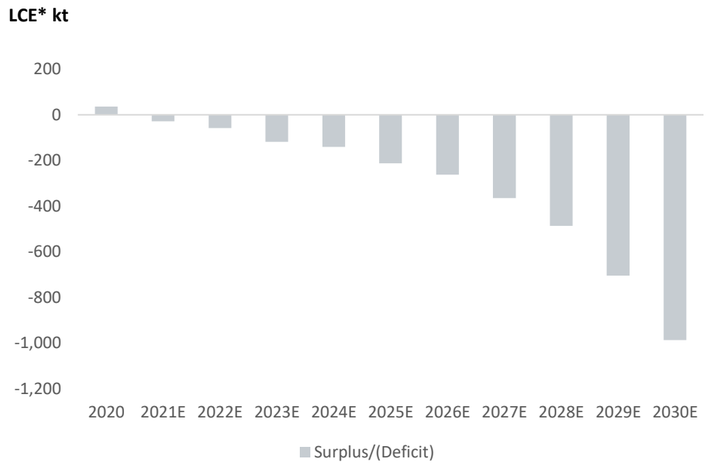
Tightening supply/demand



Lithium pricing inflecting upwards



Increasing lithium deficit for the next 10 years



*LCE: Lithium Carbonate Equivalent
Source: Spear Invest

Elevated oil prices are accelerating investments in alternative fuels. Lithium market tightness is just one example of an opportunity in EVs, but the broader opportunity includes EV OEMs, battery technologies, utility and community level grid upgrades, and charging infrastructure.

MANUFACTURING DIGITALIZATION

TREND

Manufacturing companies are undergoing an end-to-end digital transformation creating a broad universe of investment opportunities.

Innovations in the industrial software stack, along with 5G connectivity, cloud migration, and edge computing serve as enablers for this transformation.

INVESTMENT UNIVERSE

We focus our investment universe on two different areas:

- **Front end**: sales and design solutions (e.g., sales analytics, cloud based digital product design, multi-physics simulation) => faster revenue growth

- **Operations**: optimizing operations from procurement to manufacturing (e.g., digital procurement, remote monitoring, digital twin, and augmented reality (AR/VR) => higher margins

Companies are undergoing end-to-end digital transformation…

Area of opportunity	Grow revenues		Reduce costs			
	Digital sales and marketing	Digital product design & agile R&D	Digital procurement	Design to cost & design for X	Digital manufacturing	Cybersecurity and back-office processes
Trend	Use of analytics tools to improve real-time visibility and lead generation. *While CRM systems are relatively penetrated, there is an opportunity to improve other aspects of sales.*	Democratization of simulation, cloud-based product design software, agile R&D, are tools that can improve design processes and generate higher returns on R&D investment.	Digital procurement tools enable companies to streamline manual, routine procurement tasks; companies can use their data and supplier network for cost effective procurement.	Product redesign can generate significant cost savings - **80%** of manufacturing costs are determined by the design of the product.	Remote monitoring, digital twin technologies, AR/VR, can result in increased efficiencies.	Back-office optimization and cybersecurity infrastructure can result in a more efficient and safe organization.

Manufacturing Digitalization means better products, higher revenues, at lower costs which will ultimately benefit both companies and consumers. We believe this will provide a critical tool in overcoming inflation pressures.

…enabled by 5G, EDGE computing, and innovation in the software stack

5G offers many advantages over other wireless technologies

Source: McKinsey

Advantages of 5G over other wireless technologies

- Improved latency and reliability are both critical parameters for manufacturing companies, creating a catalyst for industrial IoT adoption

EDGE computing

- EGDE computing enables computation and analysis to be performed at the source, instead of accessing a centralized network, resulting in real-time decision making – key variable for critical industries (manufacturing, healthcare)

Democratizing software tools with increased compute speeds

- Customers can solve simulation problems that a decade ago would take 2 weeks in minutes with better simulation tools, hardware and software solutions

ROBOTICS & AUTOMATION

TREND

Innovation in robotics and automation is driving manufacturing costs lower, increasing adoption and new applications.

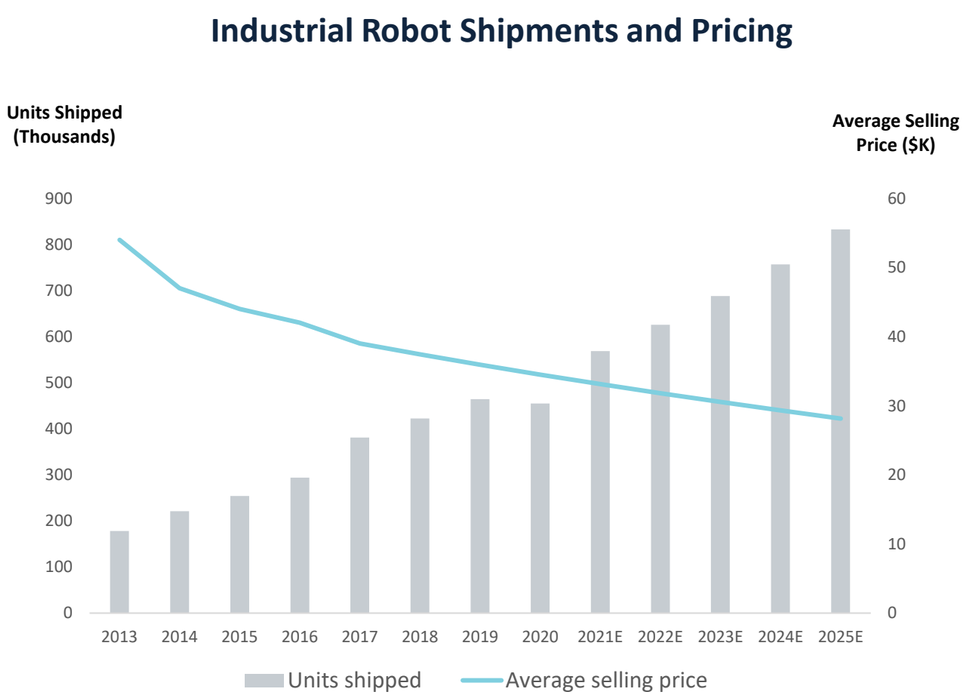
We expect US Manufacturing capex to grow well above the previous cycle benefiting robotics and automation companies:

- Announced semi plants alone add $50bn of equipment CapEx
- Localizing supply chains drive incremental investments in several other sub-sectors and ecosystems around them (battery manufacturing, biopharma etc.)

INVESTMENT UNIVERSE

We invest in companies that help automate the factory floor, provide machine vision solutions, and manufacture robotics and components.

Robot demand is increasing driven by lower prices and increasing labor cost



Source: IFR, Honeywell, SPEAR Invest estimates

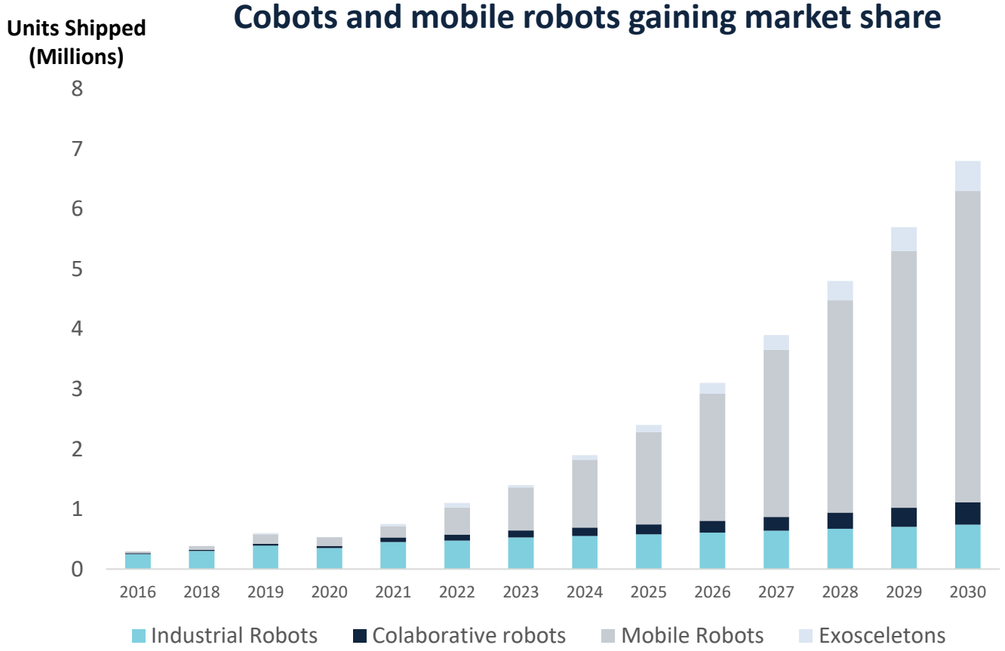
Robot demand is expected to accelerate further

- Robot unit shipments have increased at a 20% CAGR over the past ~10 years
- We expect demand to accelerate further with cobots (collaborative robots) and mobile robots significantly outgrowing industrial robots

Prices have declined while labor costs have significantly increased

- Over the past 30 years, the average robot price has fallen by half in real terms
- Labor costs have more than doubled in the same period, with significantly higher rate of increase expected over the next 5 years

Massive opportunity for cobot and mobile robot growth



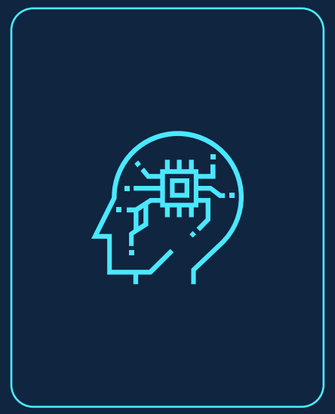
Source: ABI, Honeywell, SPEAR Invest

- Cobots (collaborative robots) and mobile robots are **more price effective** for many applications as they are easy to integrate (typical cobot costs ~35K* vs. industrial robot ~100k + 3X the price spent on installation)
- Cobot applications have been expanding – from traditional machine tending functionality to welding, palletizing, screwing, tactile sensing
- Mobile robots have been around since the 1940s, but have only recently become commercially viable due to **increased compute power**
- Mobile robots are gaining significant market share with increasing applications. **Logistics is one of the most important markets where over 80% of the tasks performed at a distribution center today are manual**

*price of a UR5 cobot with 5kg payload and 850mm reach

Robotics and automation are the solution to labor shortages and inflation – manufacturers can reduce the number of human workers required for monotonous or injury-prone tasks and redeploy them into higher-value jobs.

ARTIFICIAL INTELLIGENCE (AI)



TREND

Artificial Intelligence (AI) is the simulation of human intelligence processes by computer systems and machines.

Deep learning, a subset of AI, is finding significant applications from predictive maintenance to machine vision. Although artificial intelligence for industrial applications is in the early innings of adoption, there are many companies that are establishing themselves as leaders in their respective fields.

INVESTMENT UNIVERSE

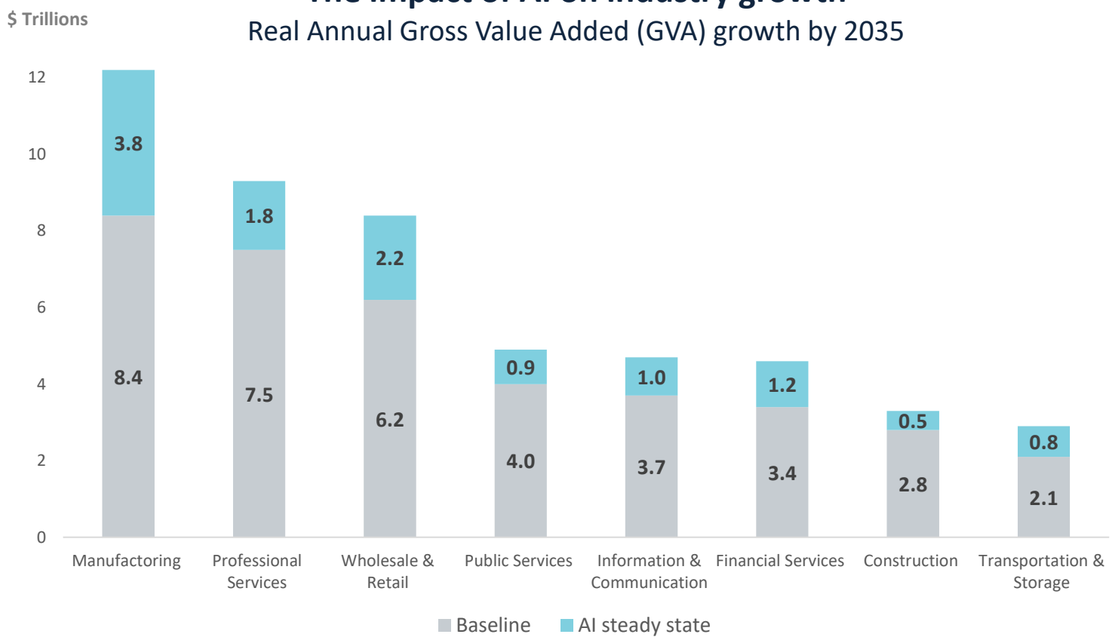
We focus our investment universe on three different areas:

- Predictive maintenance and digital twins
- Natural language processing
- Machine vision

AI can substantially raise economic output for many industries

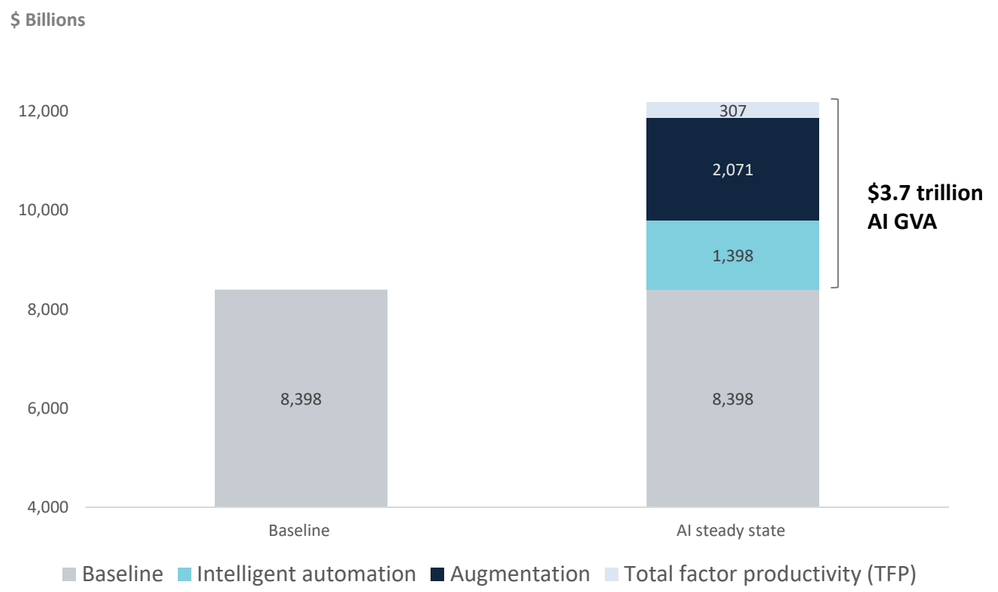
The impact of AI on industry growth

Real Annual Gross Value Added (GVA) growth by 2035



Source: Accenture, Frontier Economics, SPEAR Invest

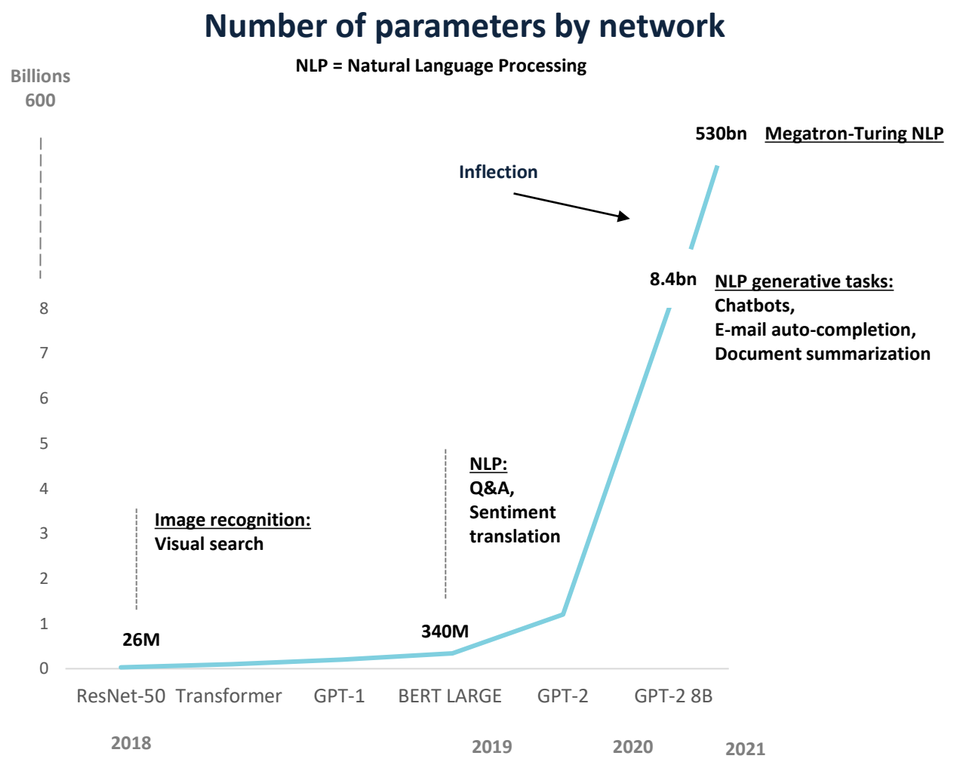
Manufacturing GVA in 2035



Source: Accenture, Frontier Economics, SPEAR Invest

*For **manufacturing** alone, AI can boost GVA by almost US$4 trillion by 2035. While AI is a relatively new market, a handful of companies are establishing themselves as clear leaders.*

Exploding model complexity means exponential need for new solutions



Source: NVIDIA, SPEAR Invest

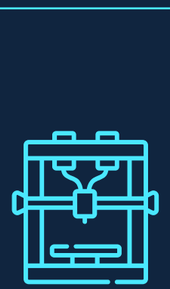
Number of parameters in AI models is growing exponentially

- Model complexity has grown from **<100 million** parameters for the ResNet-50 used for imaging, to over 500 billion for natural language processing models, in just over 2 years
- Nvidia and Microsoft announced the world's largest and most powerful generative language model known as Megatron-Turing NLP with **530 billion parameters**

Driving need for new hardware and software solutions

- A model with more than 1.3 billion parameters **cannot fit into a single GPU**, exponentially increasing demand for GPUs
- New products such **DPUs** are needed e.g., Nvidia's DGX Super-pod containing a Bluefield DPU
- Solutions such as tensor-slicing to scale models on a node, and pipeline parallelism for scaling the model across different nodes, can optimize the use of the hardware

PHOTONICS & ADDITIVE MANUFACTURING



TREND

Photonics is the technology of generating and harnessing light and other forms of radiant energy whose quantum unit is the photon.

Photonics applications have the potential to revolutionize manufacturing processes and range from high-power lasers used for manufacturing (3D printing and laser cutting) to low-power lasers used for sensing and imaging.

INVESTMENT UNIVERSE

We focus our investment universe on two different areas:

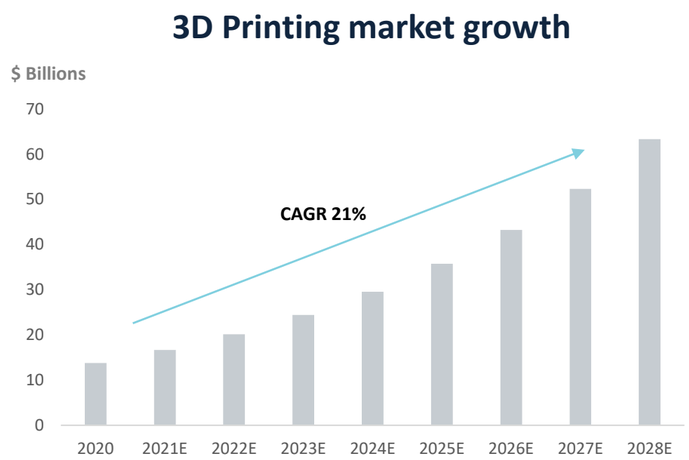
High-power lasers for advanced manufacturing:

- 3D printing generating meaningful cost savings for traditional manufacturers
- Laser-cutting disrupting traditional metalworking processes

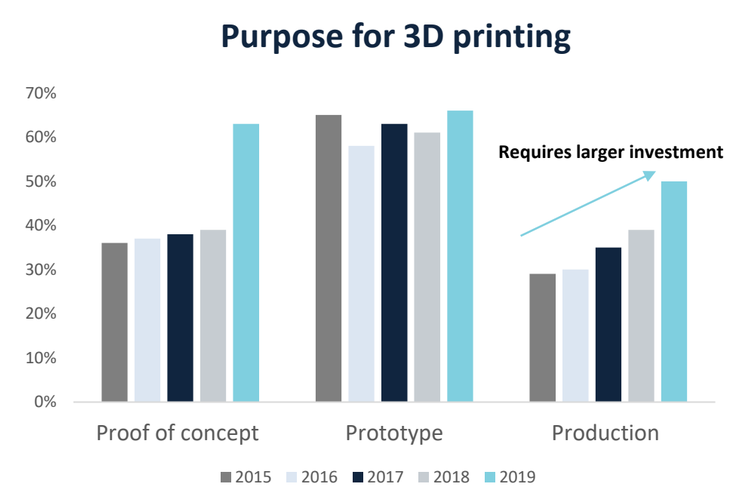
Low-power lasers for sensing and imaging applications:

- LiDAR, medical imaging

Additive manufacturing is expected to grow at a ~20% CAGR…



Source: Grandview Research, SPEAR Invest



Source: *Sculpteo Survey, SPEAR Invest

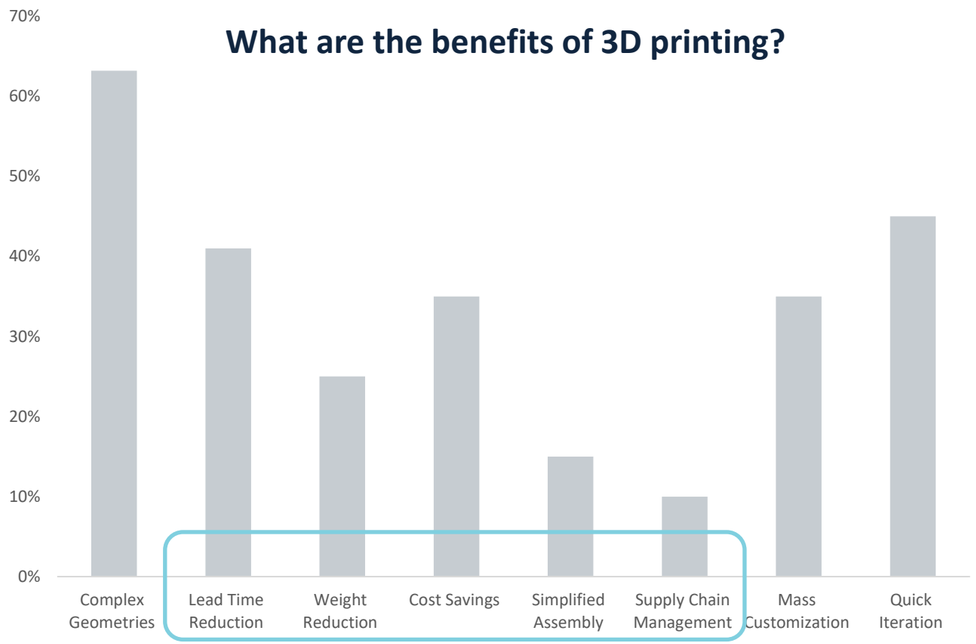
Broader adoption of 3D printing from design to production

- The inflection point in additive manufacturing is driven by use cases expanding from design and prototyping to actual production
- **Over 50%** of respondents are using 3D printing for production, compared to less than 30% in 2015 per recent survey*
- Using 3D printing for manufacturing will result in a significant a step-up in demand

Addresses many challenges relevant today

- **Re-shoring and simplifying supply chains** – 3D printers can be installed closer to where parts are needed
- **Reducing raw material cost** – 3D printing process is additive which means that there is minimal waste compared to “cutting-out”
- **Reducing CO2 emissions** – **“**light-weighing” can be a meaningful contributor to fuel efficiency

…resulting in significant cost reduction for manufacturing companies



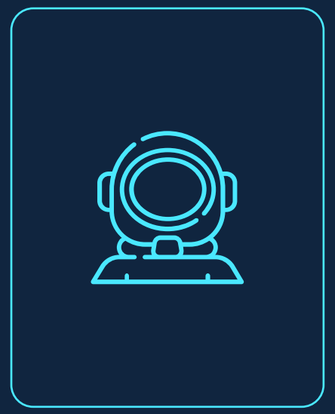
Source: Sculpteo Survey, SPEAR Invest

Aerospace and defense companies are well positioned to benefit

- *Airbus:* Parts produced by additive layer manufacturing (ALM), **weigh up to 55%** less while reducing raw material used by up to **90%**
- *Airbus:* **Every kilogram** saved prevents **25 tons of CO2** emissions during the lifespan of an aircraft
- *GE:* the GE9X engine includes more than **300 metal 3D printed parts** including low pressure turbine blades and fuel nozzles
- *GE:* the blades are lighter than traditionally manufactured ones and contribute towards an **up to 10 percent increase in fuel efficiency**

We expect that meaningful value from additive manufacturing will be captured by traditional manufacturers reducing their cost structure, creating significant operating leverage as revenues come back.

SPACE EXPLORATION



TREND

Lower launch cost, new availability of off-the shelf hardware technology, and increased accessibility through energy-efficient computing, are enabling private companies to cost-effectively develop and launch rockets and satellites, transforming a bureaucratic government run end-market.

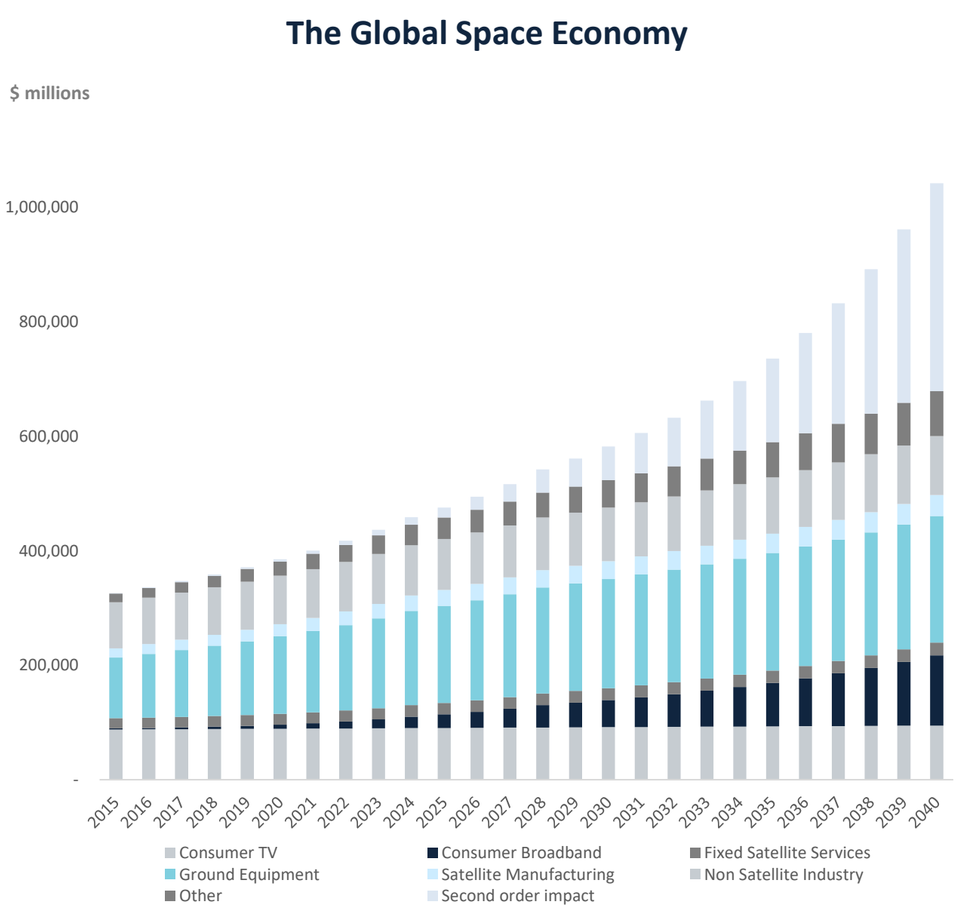
Market size could grow from $350bn today to more than $1 trillion by 2040.

INVESTMENT UNIVERSE

We focus our investment universe on four different areas:

- Broadband connectivity
- Orbital rocket and satellite technologies
- Suborbital hypersonic travel
- Ground equipment connectivity

Space industry is expected to grow to over 1 trillion by 2040…



Source: Haver Analytics, MS Industry Reports, Iridium Communications, SPEAR Invest

Rocket and satellite costs have meaningfully declined

- The cost to **launch a satellite** has declined to about $60 million, from $200 million, **via reusable rockets**, with a potential drop to as low as $5 million, per industry estimates
- Satellite mass production could further decrease that cost to $500,000

Enabling global connectivity

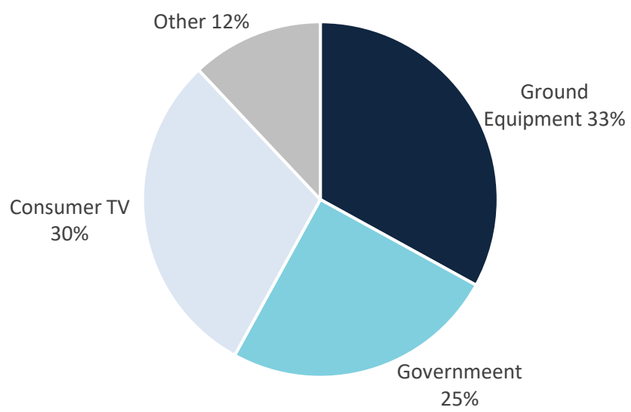
- With costs declining, many companies are launching **LEO (Low Earth Orbit) satellites**
- LEO satellites provide faster speed and lower latency and therefore can be used for critical communications

LEO vs. GEO

- LEO (Low Earth Orbit) satellites **have <300 millisecond latency.** They orbit at altitude between 100 to 1,200 miles at speed of 17,000mph completing an orbit every 100 minutes
- Geostationary Equatorial Orbit (GEO) satellites have **700 millisecond latency**. They orbit at altitude of ~22,000miles at speed of 7,000mph – move at the same angular velocity as earth and orbit along and hence appear stationary

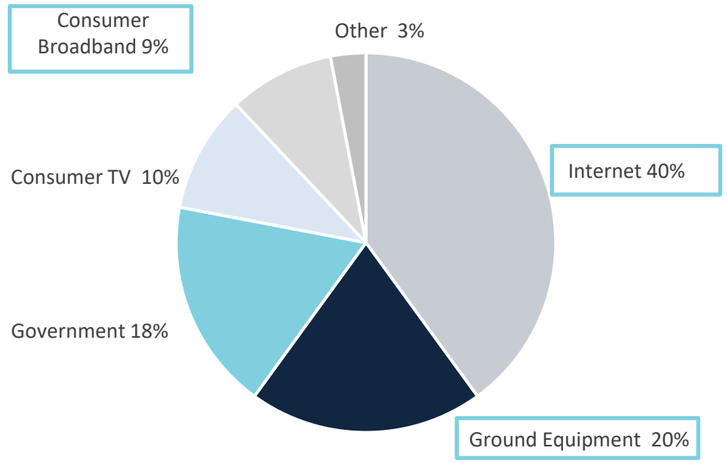
…creating whole new markets and investment opportunities

2016



Source: SIA, MS Industry Reports, SPEAR Invest

2040E



Source: SIA, MS Industry Reports, SPEAR Invest

Cost of access to space is declining rapidly, while demand for bandwidth is growing exponentially, driven by innovation in compute, collaborative virtual worlds, AI, IoT, autonomous vehicles, etc.

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