FROST & SULLIVAN

THE GROWTH PIPELINE COMPANY

Powering clients to a future shaped by growth

#SHIFTHAPPENS

June 2020

AGENDA

About Frost & Sullivan

COVID-19 Impact Analysis

- Forecast: IA Market, Industry and Regions
- Competition
- Customer

Industry and Technology Trends

- Short and mid-term trends
- Long-term trends

Customer Trends

- Critical issues
- Use cases

8 to 9 AM CT

FROST & SULLIVAN

01. About Frost & Sullivan

Who are we?

STRATEGIC IMPERATIVE: GROWTH IS THE TOP OBJECTIVE, BUT IT IS BECOMING INCREASINGLY DIFFICULT TO ACHIEVE

93% of CEOs say Growth Is Their Top Objective

CEO Tenure has Dropped from 10 to 2.5 Years over the past 30 Years

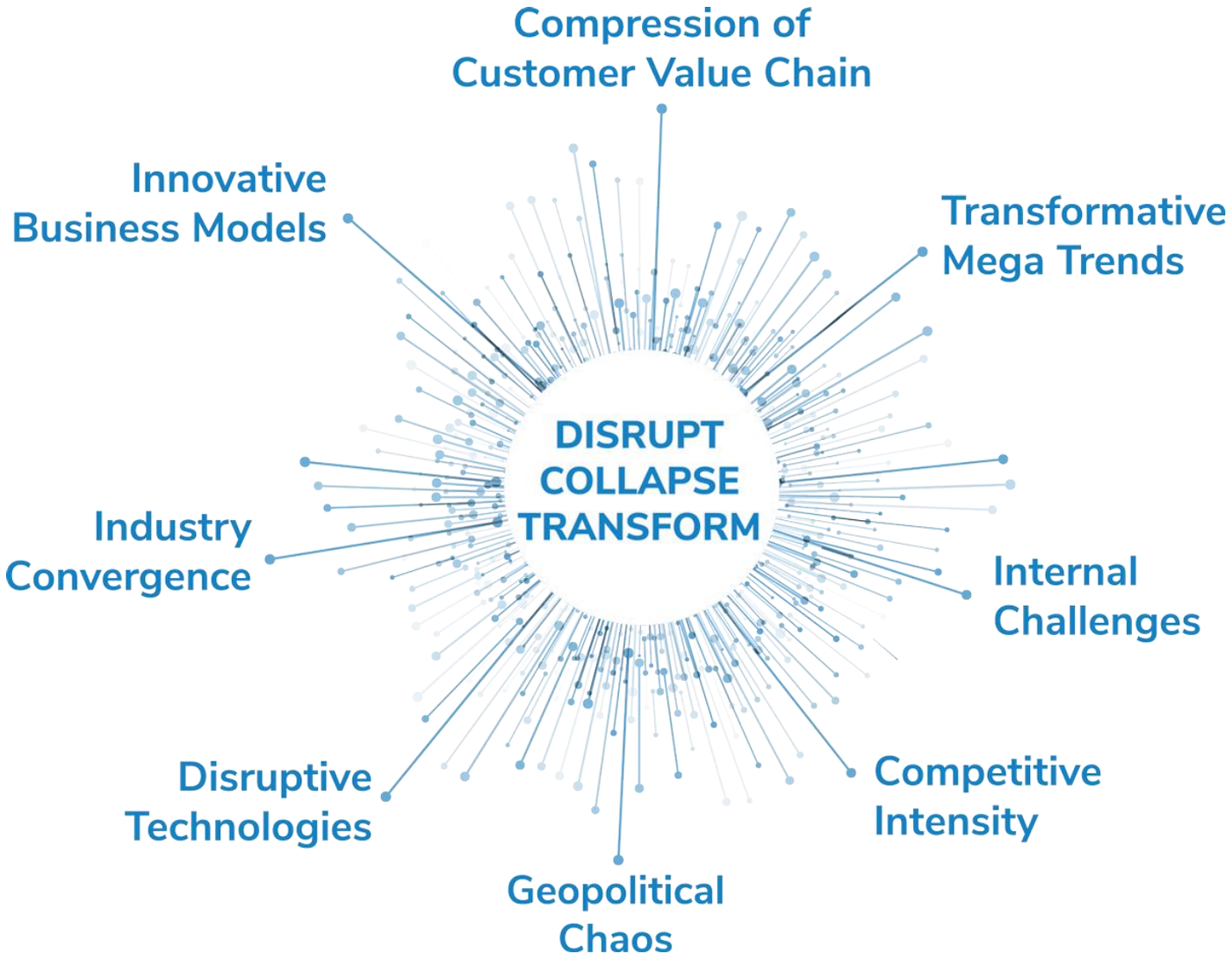
91% of Forbes Global 2000 Companies are Missing Revenue Targets

80% of Companies That Existed before 1980 Failed to Innovate and Are Gone

Source: Frost & Sullivan

WHY IS GROWTH BECOMING INCREASINGLY DIFFICULT TO ACHIEVE?

THE STRATEGIC IMPERATIVE EIGHT™: FACTORS CREATING PRESSURE ON GROWTH



Digital Industrial Transformation Track Record

Helping Diversified Industrial Conglomerates Identify Growth Opportunities and Calibrate Commercialization Models

Date	Company	Project Title	Outcome
2017	Leading HVAC supplier	**Digital business models**	Developed new business models to help in new market penetration.
2017	Industrial seals company	Pumps and seals **digital transformation playbook**	- Digital plays evaluation - Customer analytics
2018	Leading Healthcare Solutions Company	Connected Bedroom: Digital Transformation Business models	- Developed value-propositions - New business models to help in new markets entry
2018	Leading ICT company	**Digital Transformation for Automotive, Machinery Manufacturing**, Smart Spaces and Aviation	- Leveraged digital as the cross-innovation lever to drive growth across its business platforms - Commercial approaches - Build/buy/partner strategies
2018	Industrial seals company – Repeat project	Business models and pricing models assessment	- Follow-on project to develop commercial approaches for the digital plays
2018	Largest NA automation company	Valve Service **Digital Transformation Playbook**	- Leverage digital services to check feasibility of a new business unit - Commercial approach development - Customer analytics and propensity to buy - Channel strategies
2018	Largest construction equipment company	**Digital services transformation** for Engine Customers	- Understand Segmentation, Customer Value, Adoption - Best Practices and Recommend Key Elements of Go-to-Market Strategy and Business Model
2018	Independent O&G drilling equipment	Digital Transformation of **Drilling/Future of Drilling**	- Develop the technology roadmap of automation in drilling systems - Uncover industry gaps, opportunities and strategic imperatives
2018	Independent oilfield equipment and technology company	**Digital services for Energy Value-stream**	- Identify digital plays and its associated business models and pricing models. - Create an objective view of business case for digital to be the biggest revenue generator by 2021
2019	Third largest oilfield service and equipment company	**4IR play identification – Enterprise level and for a business unit**	- Identify 4IR implications across the organization's $20B+ portfolio - Transform a product companies outlook and develop a 3Y digital strategy

GROWTH PIPELINE ENGINE™
A PROVEN, TRUSTED AND VALUED PROCESS – PERFECTED OVER 50 YEARS OF OUR EXISTENCE

5- Step Process

Opportunity Universe

Identification of the range of growth opportunities

Opportunity Evaluation

Deep analysis of prioritized opportunities

Go-to-Market Strategies

Translation of strategic alternatives into a cogent strategy

Planning & Implementation

Implementation of specific plans with milestones, targets, owners, & deadlines

Monitoring & Optimization

Optimization of strategies & implementation actions

Source: Frost & Sullivan

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02. COVID-19 Impact Analysis

At this juncture, recovery will be a long-drawn out process. We expect different recovery time frames across various businesses. At a high-level, we expect markets to enter positive territory by Q3, 2021. Further, the world may go into a lock and release cycle, every three months depending on infection rates.

Global Visioning Scenarios

COVID-19 RECOVERY PHASES, GLOBAL, Q1 2020 – Q3 2021

Q1, 2020 to Qx

RESPOND

- Lockdown affects production and supply
- Unemployment to reduce demand and consumption
- Investments on hold due to volatility and tight cash flows

Q2, 2020 to Q3, 2020

RESET

- Lock and release cycles with some demand spurts
- Fiscal stimulus, tax deferment and interest rate cuts
- Loosening of austerity measures
- Improvement in consumer and business sentiment

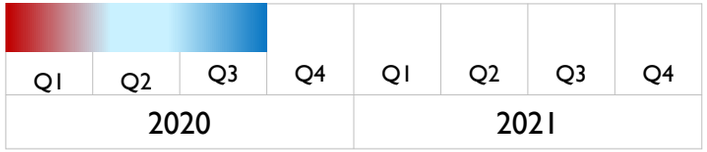
Q4, 2020 to Q3, 2021

REBOUND

- Demand revival - Rise in private and public spending
- Increase in business confidence to spur CAPEX
- Production, employment and economic activity to rise
- Air travel ramps back to normalcy

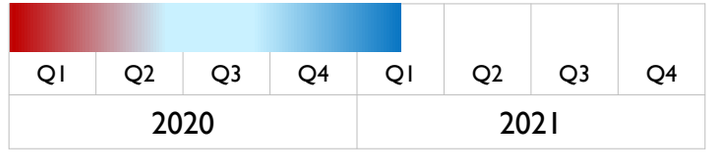
VISIONING CASE SCENARIOS, GLOBAL 2020 – 2021

QUICK RECOVERY (Unlikely case) ▶



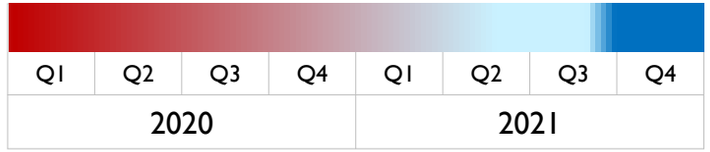
- Expiration of most lockdowns by May and partial economic rebound across most economies in May.
- Demand and production drop sharply during the second quarter and return to normalcy by Q4 2020
- Unlikely,

MODERATE RECOVERY (Probable CASE) ▶



- Lockdowns release in May, but infections rise up to drive a lock and release cycle, every three months.
- Stock market impacted, due to growing U.S. and China geopolitical tensions
- Industries look to re-shore from China

DRAWN OUT RECOVERY(Most Likely CASE) ▶



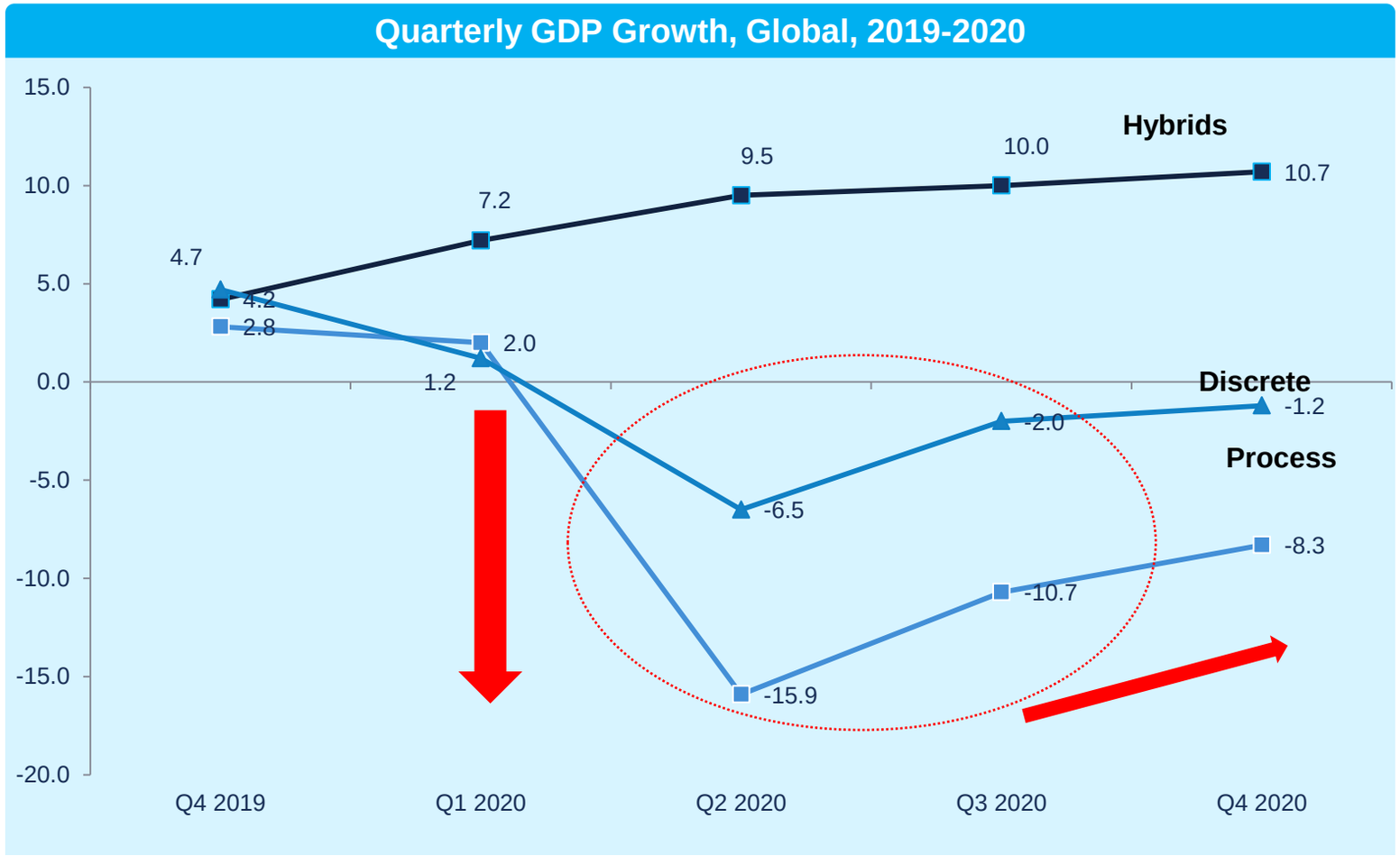
- COVID-19 cases to continue unabated till end of Q4. Another wave in fall will lead to economic lockdown.
- Investments are frozen, but new normal realization will progressively open up spending. This may start by Q2/Q3 2021.

Source: Frost & Sullivan

COVID-19 Implications on Industrial and Energy Markets

COVID-19 Impact	Business Implications
Double-whammy leads to CAPEX and OPEX cutbacks	Operating companies (O&G) on an average have cut back 40% of CAPEX and 15% on OPEX. This would mean acute pressure on spending, unless the spend is related to safety, security or compliance.
Remote operations/un-tethered workspaces	**Increased need to monitor, manage and optimize plant operations** remotely. Virtualized infrastructure, remote technology investments, remote maintenance and support will emerge as some of the key needs.
Increased connectivity leads to a high degree of vulnerability	Hyper-connective infrastructure will lead to rise in **spear-phishing, insider threats, ransom ware and malware.** Visibility of threats is key, while managing deep packet inspection will help in security posture.
Increase in consumable consumption	Downstream chemicals and petrochemicals see short-term offtake. Isopropyl alcohol, polypropylene production will increase. These industries are the silver lining.
Cratering oil prices will take at least 12-14 months to recover	This the new normal. Operating companies will see tough quarters, refining output will decline or be re-purposed. Market will see an **exponential adoption of digital technologies to keep costs in check.**
Extension of turnaround cycles	Avg. industry turnaround cycle is 2 years. This is pushing customers to extend turnarounds beyond 3 years. **This would drive customers to prefer longer MTBF with better 'first line of defense' solutions.**
Service growth will be largely unaffected	Solution providers should double-down on offering service value-propositions around **training, virtual commissioning, data analytics and system health checks.** Service profitability will increase.

Our Models Predict a Year Long Recession, but the Dynamics of Situation Demands Frequent Forecasting



- Chemicals, petrochemicals, storage facilities face short-term focus and gains.
- Lifesciences, F&B, Medical devices buck the downward trend
- Pockets of growth opportunities exist, with digital technologies expected to see exponential adoption rates as the market recovers.

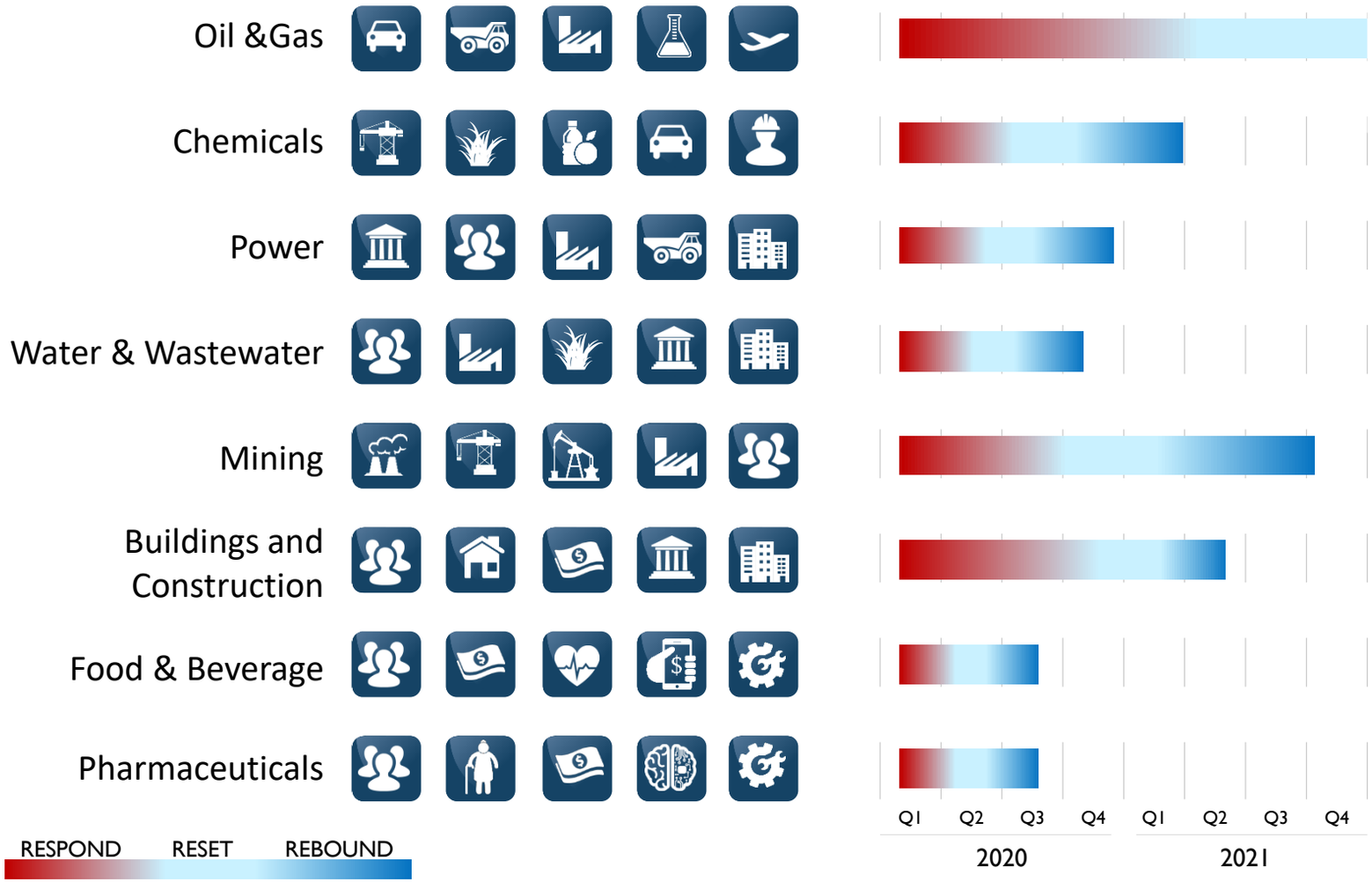
Magnitude of Disruption

Industry	Depth	Length	Shape
Process	Next 12-15 months will see a crater	Five quarters of –ve growth leads to a full-year recession	• Bath tub recovery model. Oil and gas is worst hit. • Chemicals and Petrochemicals are the silver lining, • Power will remain moderate
Hybrids	Not affected	Steady growth across F&B, Lifesciences, CPG.	• Consistent growth as per market average.
Discrete	Next 9 months	Delayed sharp recovery	• V-shaped recovery but markets won't return to positive levels until late part of Q1 2021.

Source: Frost & Sullivan

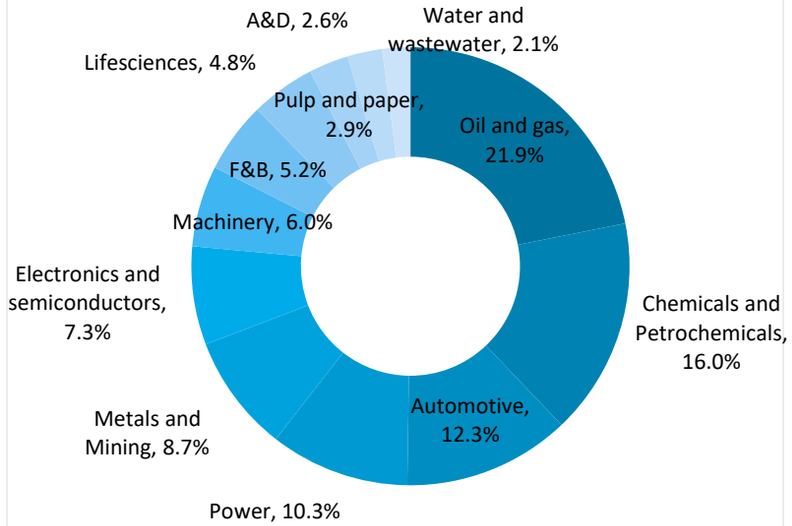
End-user Outlook

KEY FACTORS IMPACTING RECOVERY & EXPECTED TIMELINE



INDUSTRY SEGMENT, GLOBAL, 2019

REVENUE BY KEY SEGMENTS



Source: Frost & Sullivan

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03. Industry and Technology Trends

Top trends impacting industrial and energy markets

TREND 1: EVERY BUSINESS WILL BECOME A CONNECTED BUSINESS

PLATFORM INFRASTRUCTURE IS ESSENTIAL FOR THE FUTURE

Ageing assets, plants and workforce are three forces that will drive an exponential adoption of connected business models.

Past

Stock & Flow Business Model

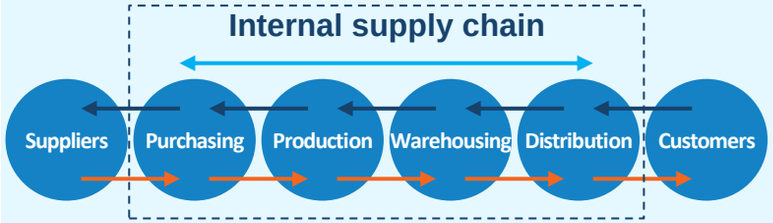
New and replacement sales inventory management associated services

Communication Flow ⟷

Product Flow →

Cash Flow ←

Return Flow ←



- *Transactional approach*
- *Relationship driven*
- *Limited accountability and project stake*

Current

Product + Service-based Business Model

Product → **Service** → **Ongoing Services**

Product sales combined with service models

Primary products → Extended services, PaaS → IoT solutions, AI support → Purchase analytics, DaaS → Ongoing solutions, sales optimization

Future

Digital Delivery & Outcome-Driven Business Model

Platformized Solutions → **Data & Insights** → **Business Outcomes**

- *Proactive collaboration on solution delivery across the ecosystem*
- *Embedded digital technologies within assets and equipment*

Platformized outcome-based delivery

Early collaboration at bid & spec stage

Solution selling with AI support

Source: Frost & Sullivan

TREND 2: AUTOMATION → AUTONOMY

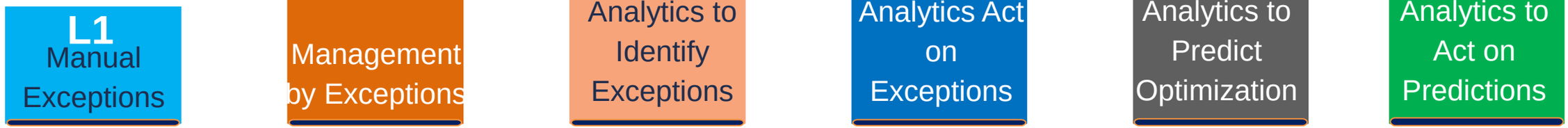
ENTERPRISE SCALING OF AI, ACROSS A CUSTOMERS VALUE-CHAIN

"**Autonomous oilfield** is the big project, this year – **everything is instrumented, automated**. **Devices make self adjustment** correction. We have guys that operate the wells, facilities and drilling rigs. This is looking at the integrated systems and uses a model approach to operate more efficiently. Use a concept called as **'virtual control room'** – we are presenting the data, wherever they are at."

Took the industry 20Y to get here. Driven by automation

<15% of the industry are positioned here

Cognition to enable autonomy. Adoption by pioneers, first. L6 by 2025.



Machine learning. Last time, you had a problem, this action was taken. This time, since it is the same problem, same actions will be taken.

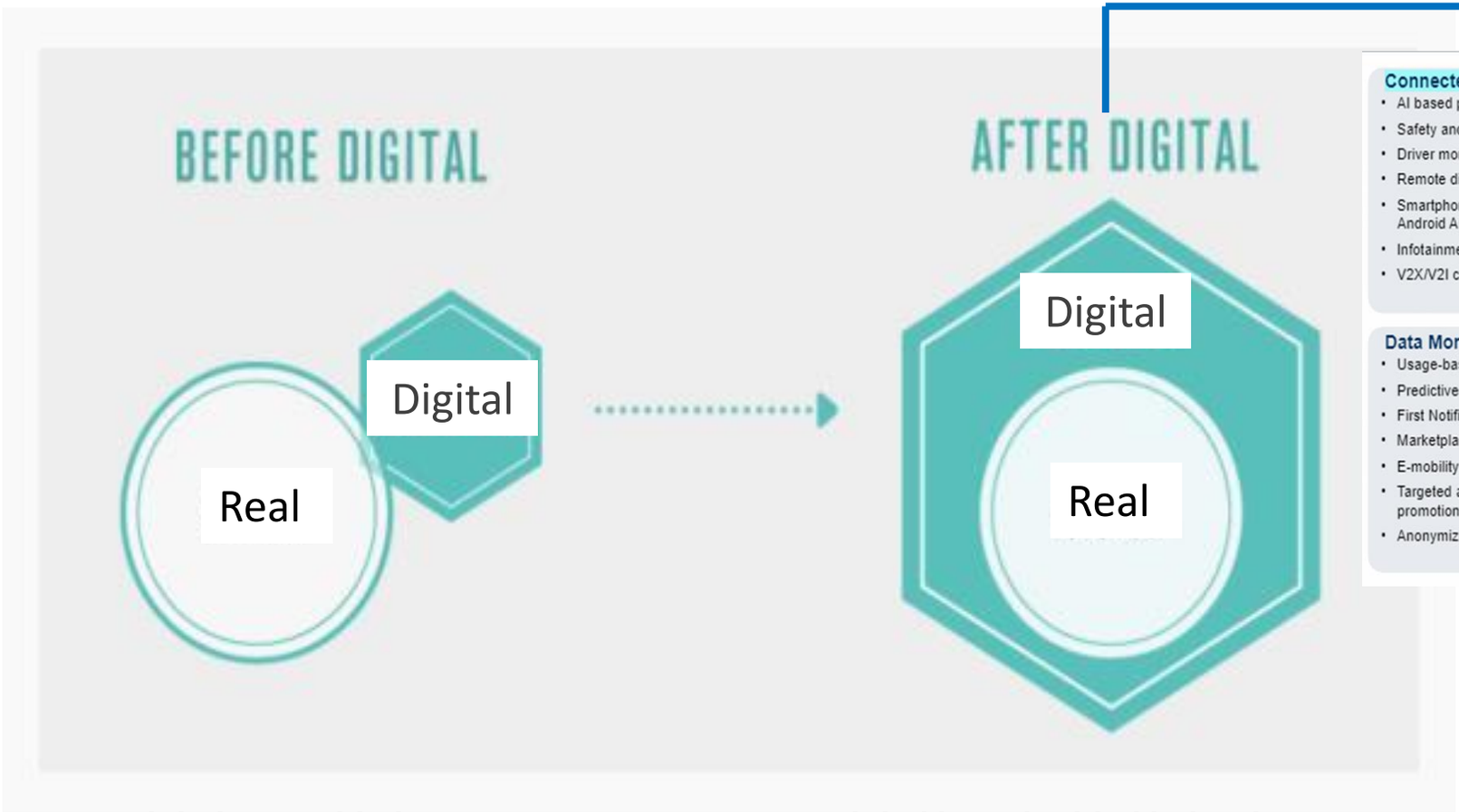
Rather than saying, I have a high tank level – Your tank will overflow in 2 hours.

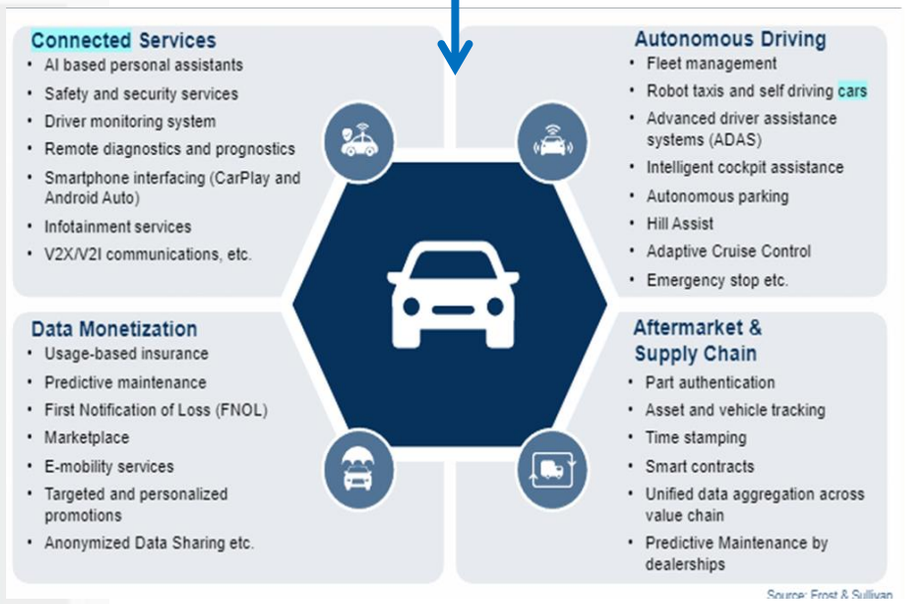
I see that my tank will overflow in 2 hours and I will cut the high water well.

TREND 3: GOLDEN AGE OF HARDWARE SET TO MAKE A COMEBACK

SENSING → SENSEMAKING. DUMB ASSETS → SELF-HEALING ASSETS

Online merges with offline - Instead of focusing on the online world and thinking of digital as an added value, we think of the world as an integrated social systems, with all industries updated by digital.





Digital was added as an after-thought. Ex: Modernizing ageing assets

Digital is embedded in hardware to drive services and potentially self-optimization/autonomy network effect

Inspiration from connected car ecosystem can be applied on critical assets like turbine, oilfield systems (AL), subsea production platforms, aero derivative turbines, etc.

TREND 4: 3-LAYER ARCHITECTURE WILL REPLACE TRADITIONAL 5-LAYER

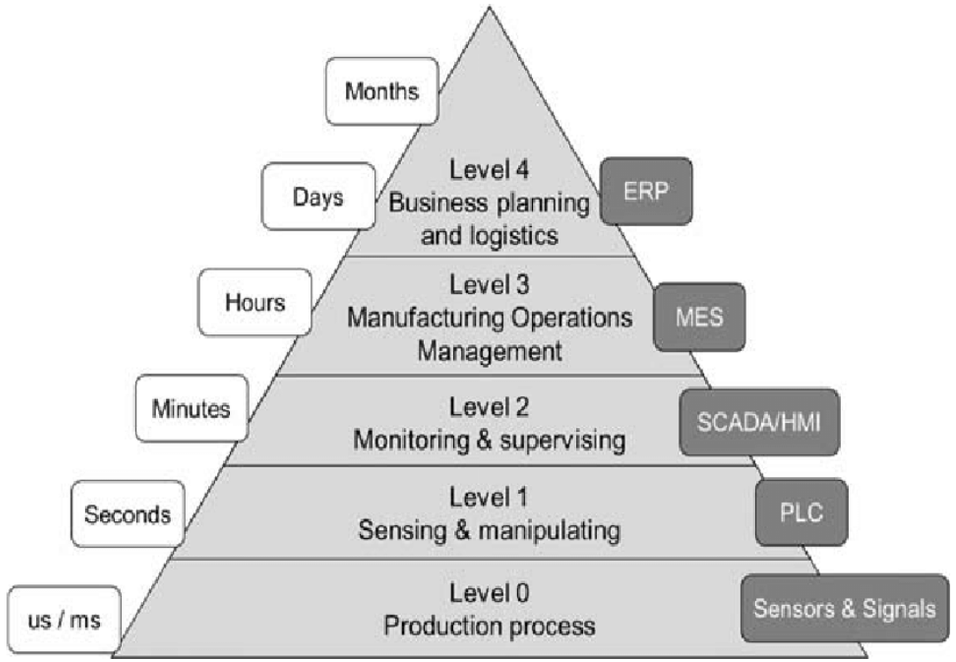
A CREATIVE DESTRUCTION and EXPANSION OF INDUSTRY STRUCTURE

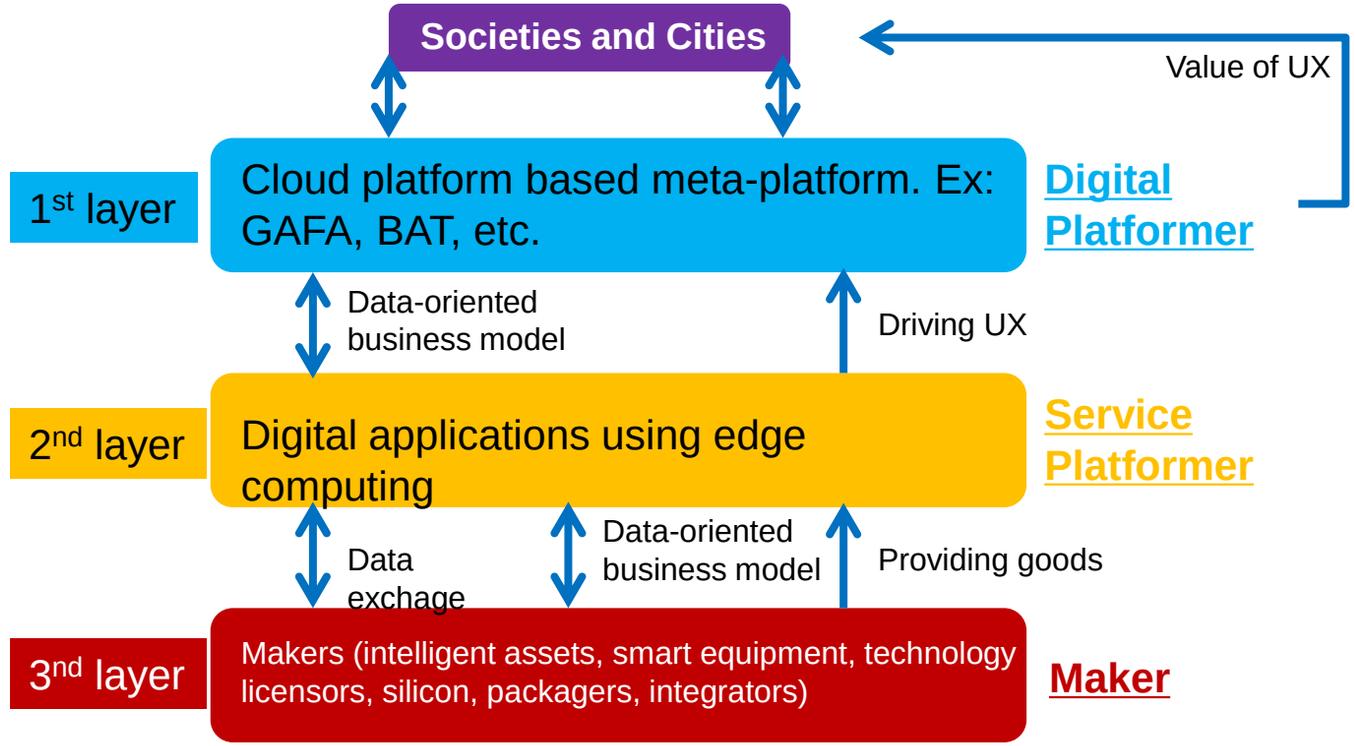
Solution providers will align themselves to one of the three layers, with innovation on business models driving revenue monetization.

Markets aligned with products, software and field services

Forward to 2035

Markets aligned with business models, openness, ecosystem and infrastructure





Customers consumption of technology was also aligned with products and inhouse maintenance

Customers will become a part of society, consuming services from digital platformers (Google, Amazon, Facebook, Apple; Baidu, Alibaba, Tencent). Profit pool value for service platformers and makers will depend on quality of service/outcomes provided.

TREND 5: DATA AND SERVICES COMBINE FORCES

PREFERENCES AND SERVICES WILL BECOME INDIVIDUALIZED

	Data-As-A-Service	Circular Economy	Everything-As-A-Service	Shared Economy
What is it?	The act of productizing data and trading it through bartering, brokering and/or business intelligence models, which analyze it to offer critical insights.	This is an industrial economy that, contrary to the traditional linear economy, reclaims used materials and recycles them as secondary raw materials for new products.	This is a monetization model whereby a business that traditionally sold its wares to customers, now sells them as a service.	This is a personalized product or service, which is better tailored to suit customers' individual needs. Technology could be often leveraged to achieve this at a competitive price.
What are the three major driving Indicators ?	• Analytics to generate insights • Customer Or Company related research • Productivity Insights	• Reuse and repurposing of products • Climate change • Service- based business models • Resource optimization	• Shift from Capex to Opex based model of purchasing • Outcome focussed services • Cost savings	• Mobile connectivity • Cloud and edge computing • Increasingly automated society • Availability of labour
What are the ley Application Areas ?	• Data Aggregation • B2C Monetization • B2B Monetization • Data Platforms	• Oil & Gas • Mobility • Steel • Building Environment	• Platform-As-A-Service • Analytics-A-A-Service • Energy-As-A-Service • Mobility-As-A-Service	• Mobility • Financial services • Space & Services • Education
What are the implications for 2025 and beyond ?	• Automotive, IT, Healthcare, Telecommunications and the Energy Sector will tremendously advance with innovative services.	• Integration of recyclable and reusable materials into product chain. • Decreasing usage of plastics	• Shift to –As-A-Service plans • Energy, Mobility, Analytics, Healthcare, and Security will be the key growth markets.	• Connectivity models will be co-operation and sharing based • Governments will play a larger role in regulating services
What is the 5-10 year future vision ?	• Shift from traditional to non-traditional companies for data monetization needs • Growth in data related products • Increase in productivity	• Close loop recycling, reuse, and refurbishment process • Climate change concerns will receive greater media coverage which will influence decision making	• Future XaaS models will be highly individualized, responsive data-driven and full controlled by customers • Information based services will focus towards pricing and business innovation	• Increase in the competition for shared services, asset ownership will be playing a key role. • Development of more B2B and B2C shared business models

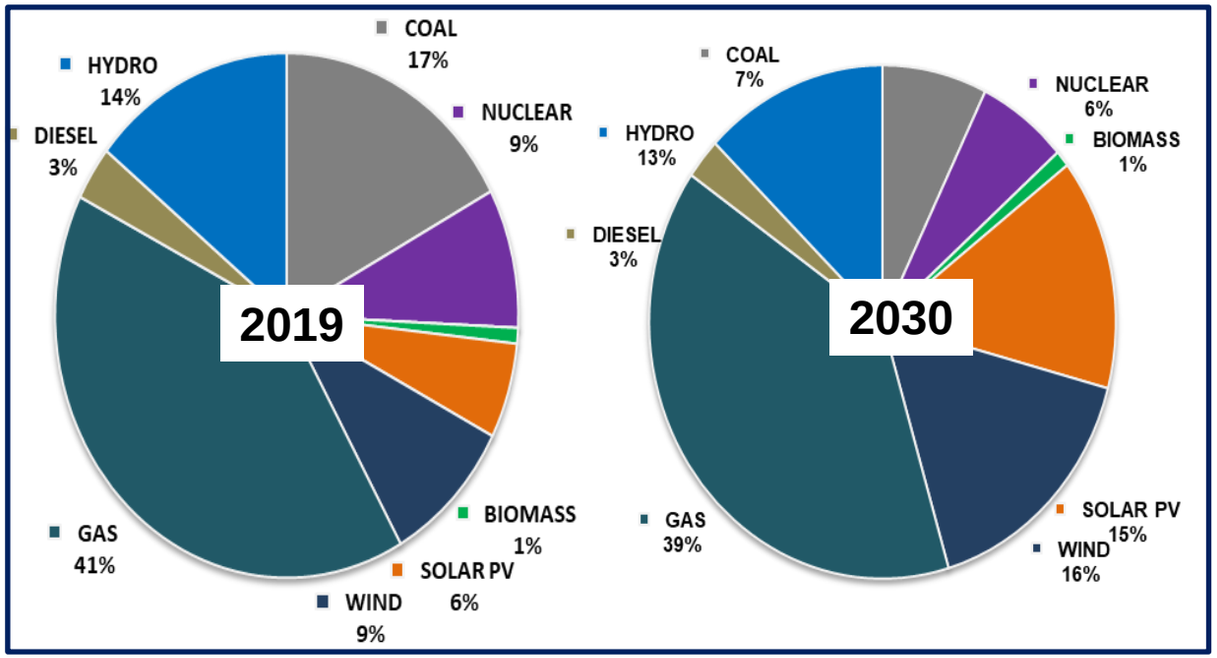
Source : Frost & Sullivan

TREND 6: ENERGY MIX WILL CHANGE

GAS SLOWDOWN, RENEWABLE WILL TAKE-OFF

De-centralization, digitalization and de-carbonization will re-shape future energy markets. Remote windfarms will become multi-billion $ opportunity in near future.

Utility Scale Installed Capacity Fuel Mix, North America, 2019-2030



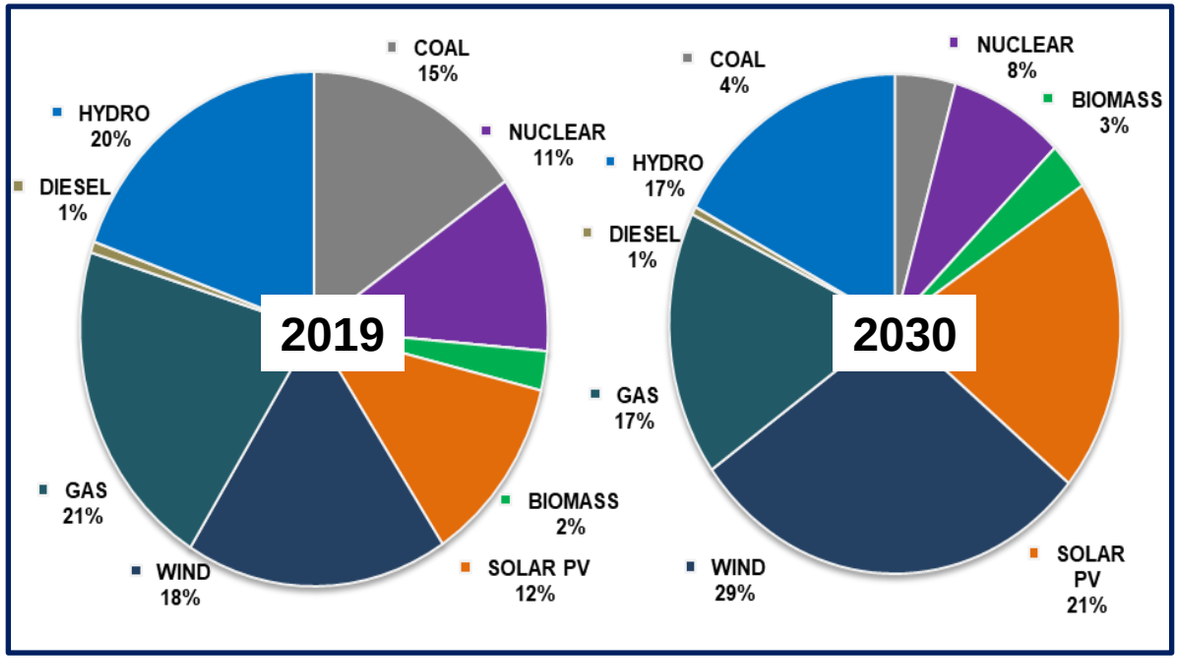
2019 Capacity

1329GWh

2030 Capacity

1513GWh

Utility Scale Installed Capacity Fuel Mix, Europe, 2019-2030



2019 Capacity

1131GWh

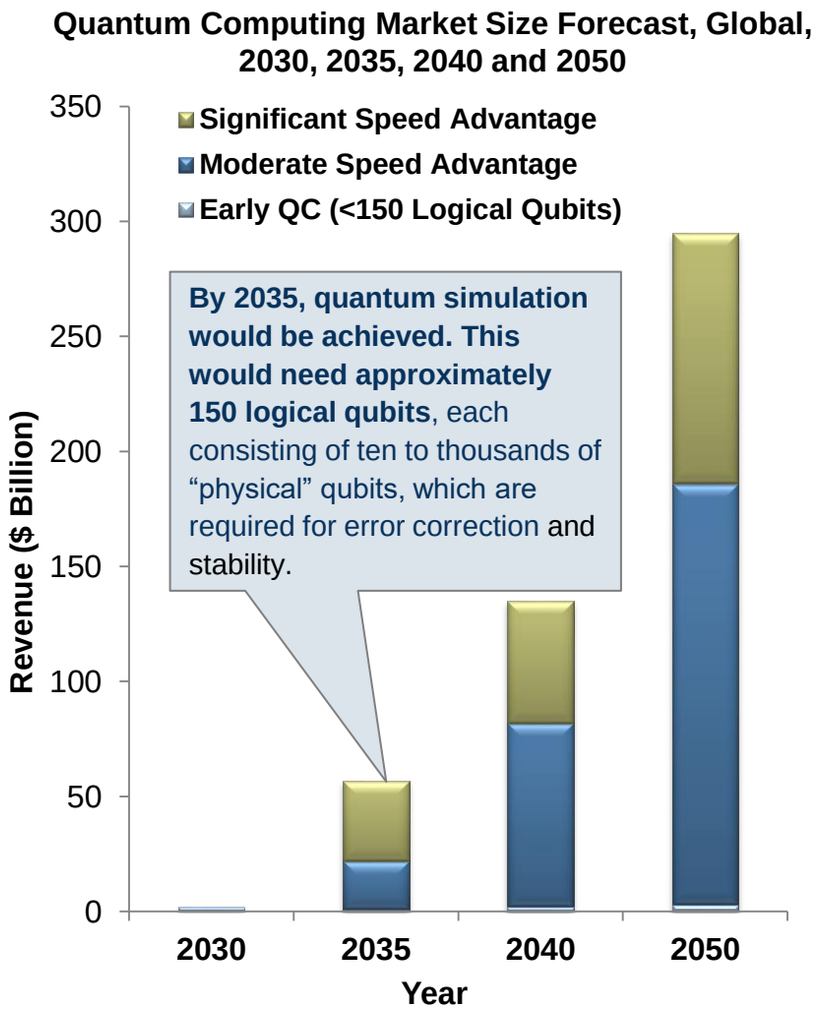
2030 Capacity

1441GWh

TREND 7: Advanced COMPUTING: QUANTUM AND NEUROMORPHIC

FIRST GRADE GENERAL PURPOSE QUANTUM COMPUTERS EXPECTED by 2030

Quantum computers will completely eliminate the time barrier and eventually minimize the cost barrier reducing time-to-solution from months to minutes.



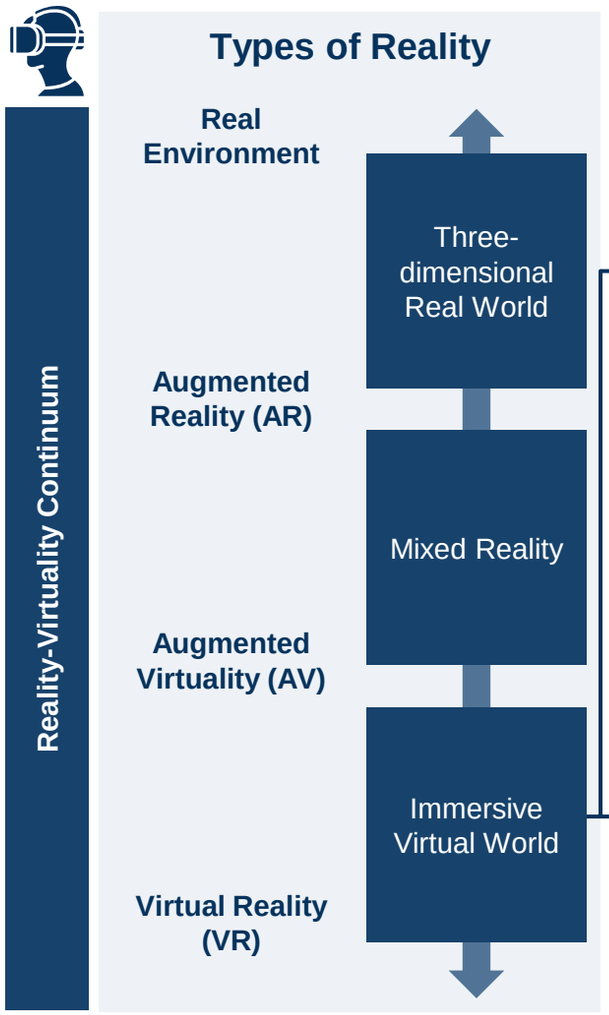
Industry	Potential Use Cases
High-Tech	• Machine learning and artificial intelligence, such as neural networks • Bidding strategies for search-based advertisements • Online, customized service and product marketing • Software verification and validation • Cybersecurity
Industrial Goods & Manufacturing	• **Logistics:** Scheduling, planning, product distribution, and system routing • **Automotive:** Traffic simulation, eCharging station and parking search, autonomous driving, and eVTOLs • **Semiconductors:** Manufacturing, such as chip layout optimization • **Aerospace:** R&D in manufacturing, such as fault-analysis and stronger polymers for airplanes • **Material Science:** Effective catalytic converters for cars, battery cell research, more-efficient materials for solar cells, and property engineering uses such as OLEDS
Chemistry & Pharmaceuticals	• Catalyst and enzyme design, such as Nitrogenase • Pharmaceuticals R&D such as faster drug design, clinical trials, and drug discovery • Bioinformatics, such as genomics • Patient diagnostics for healthcare, such as improved diagnostic capability for MRI

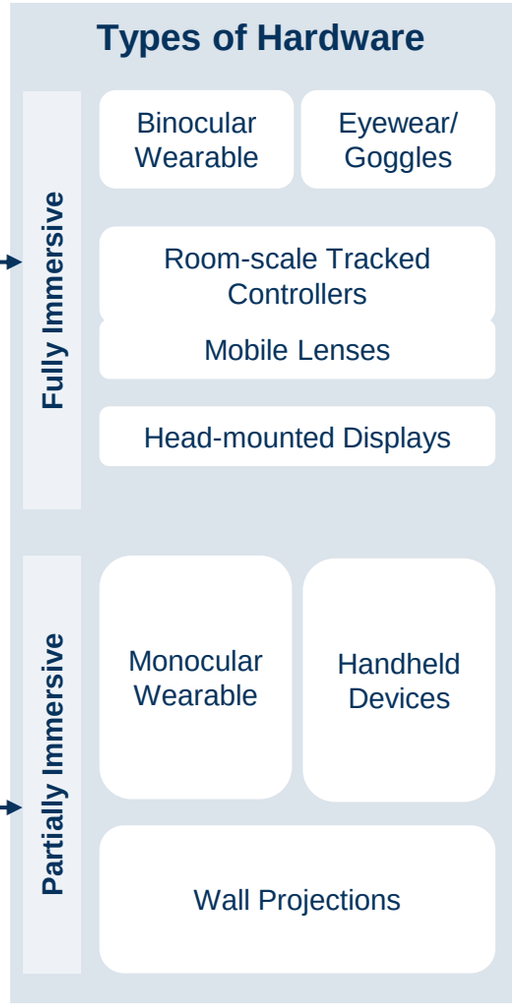
Source: Frost & Sullivan

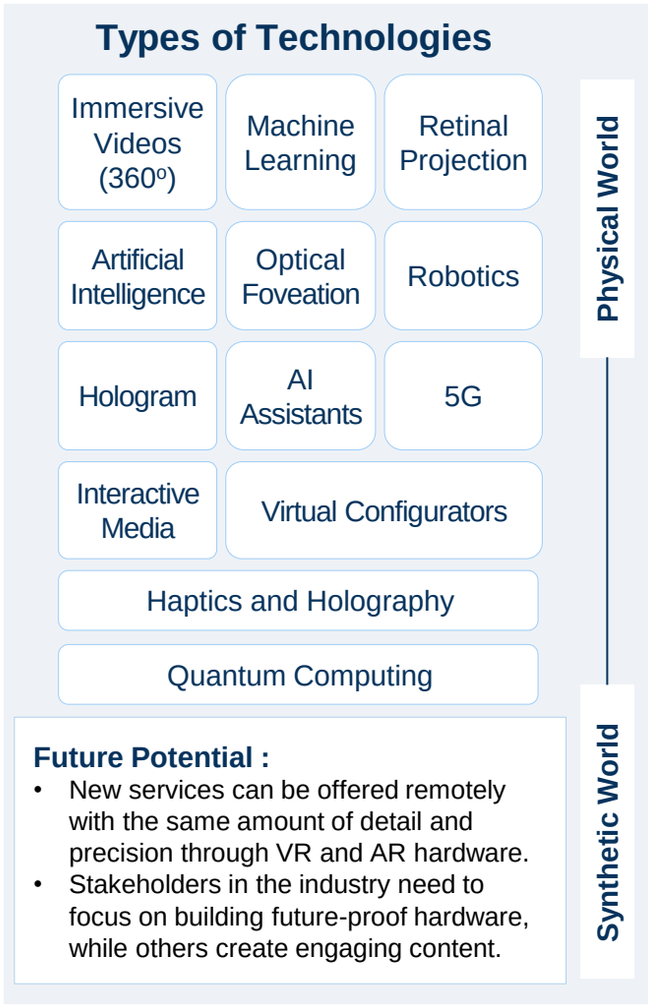
TREND 8: AR and VR will merge to provide a Reality-virtuality continuum

REMOTE SERVICES WILL DRIVE A CONVERGENCE OF TECHNOLOGIES

A new race for building the largest content for industrial ecosystem by attracting developers.







5–15 Year Future Vision for the Trend

By 2022, **nearly 23 million augmented reality or mixed reality glasses** will be sold per year.

By 2025, China is expected to lead the VR market, with investments pouring into patents, standards, and products.

AR, VR, and robotics will merge to develop virtual reality robots, which will have a huge impact on manufacturing, retail, security, healthcare, and defense.

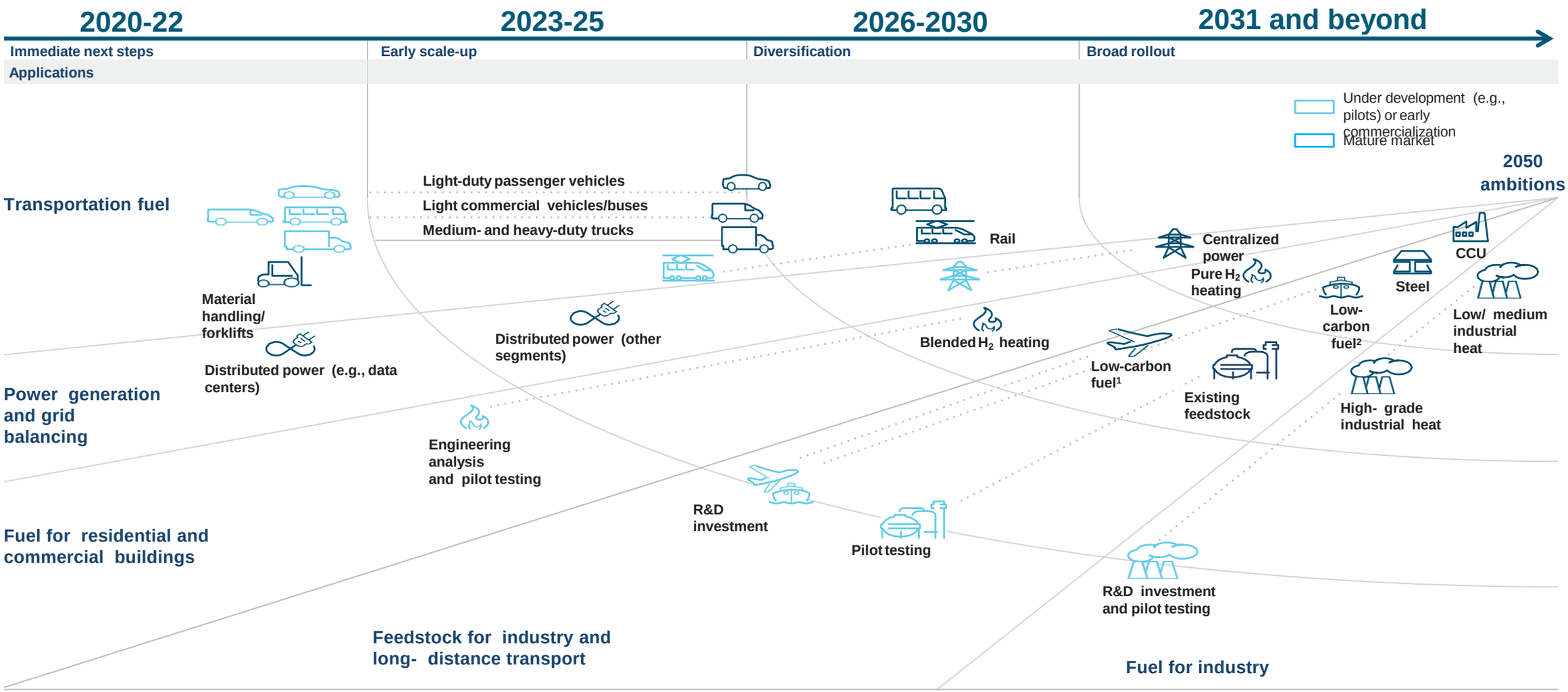
Beyond 2030, AR and VR will eventually merge, allowing users access to the total reality-virtuality continuum.

Source : Frost & Sullivan

TREND 9: HYDROGEN ECONOMY OF THE FUTURE

FAR reaching and promising applications could drive a broad rollout

Infrastructure build out and disruption across power industry will be key things to watch out for.

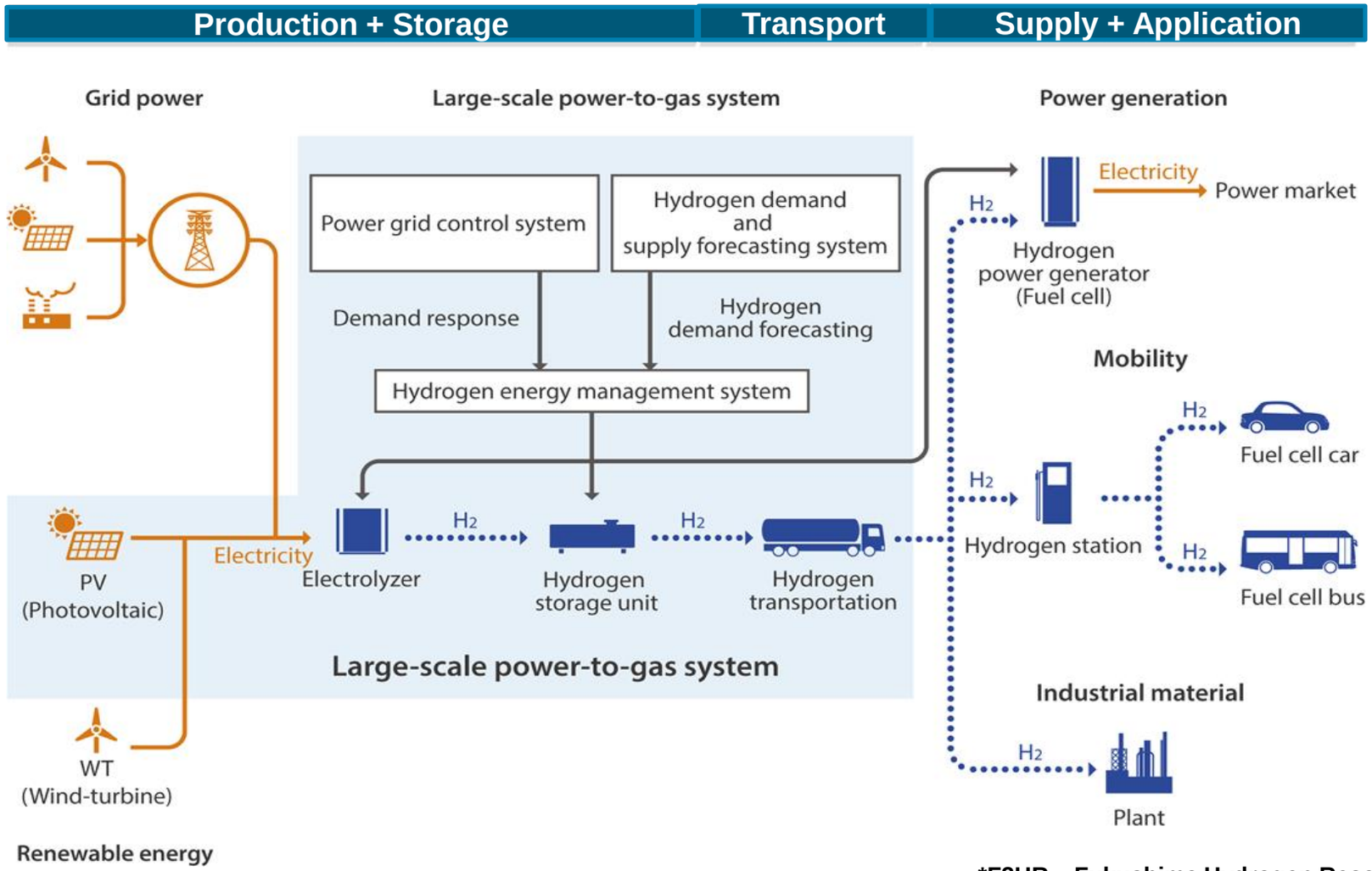


1 Carbon capture and utilization (for chemicals production)
2 Biofuel, synfuel, ammonia

Source : Hydrogen North America & EU & Frost & Sullivan analysis

HYDROGEN USE CASE FROM TOSHIBA

Trading platform, total system monitoring and optimization, hydrogen metering solutions, infrastructure build out for plant use are some of the key growth areas.



***F2HR – Fukushima Hydrogen Research Field**

Stakeholders

TOSHIBA
Supervision of overall project and the energy management system

東北電力
Energy Management System + SCADA + Grid Related Functions

Iwatani
Hydrogen demand and forecast systems, transportation and storage of hydrogen

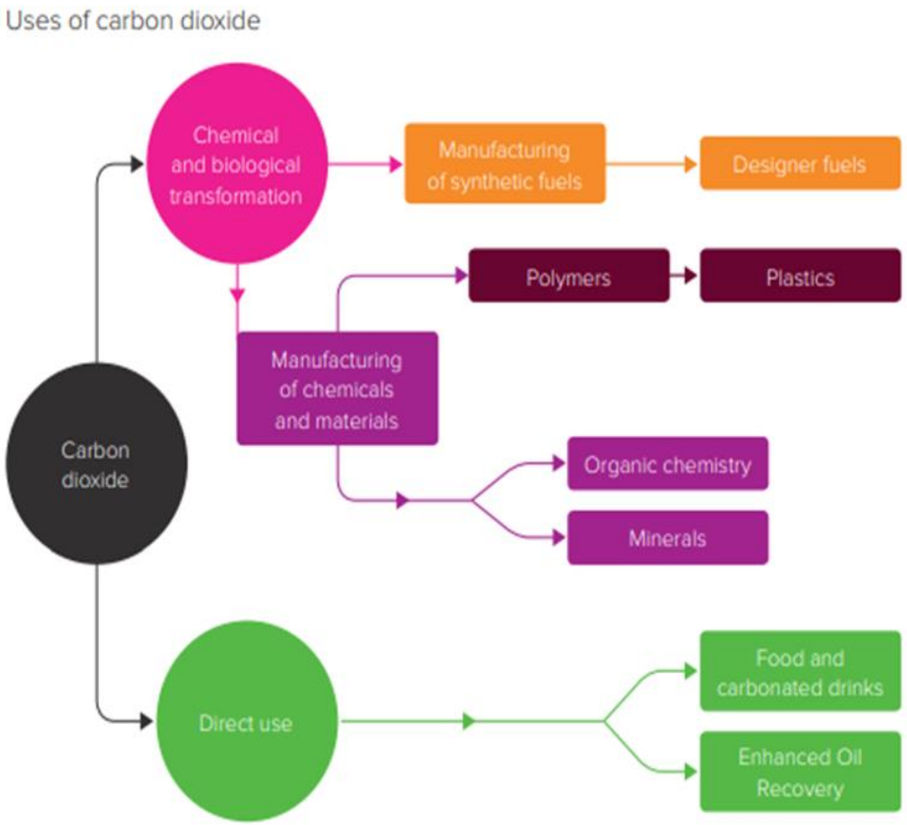
Source : Toshiba & Frost & Sullivan analysis

TREND 10: CARBON CAPTURE ECONOMY FOR DOWNSTREAM PRODUCTS

15% of GLOBAL CO2 emissions could be used per year by 2030

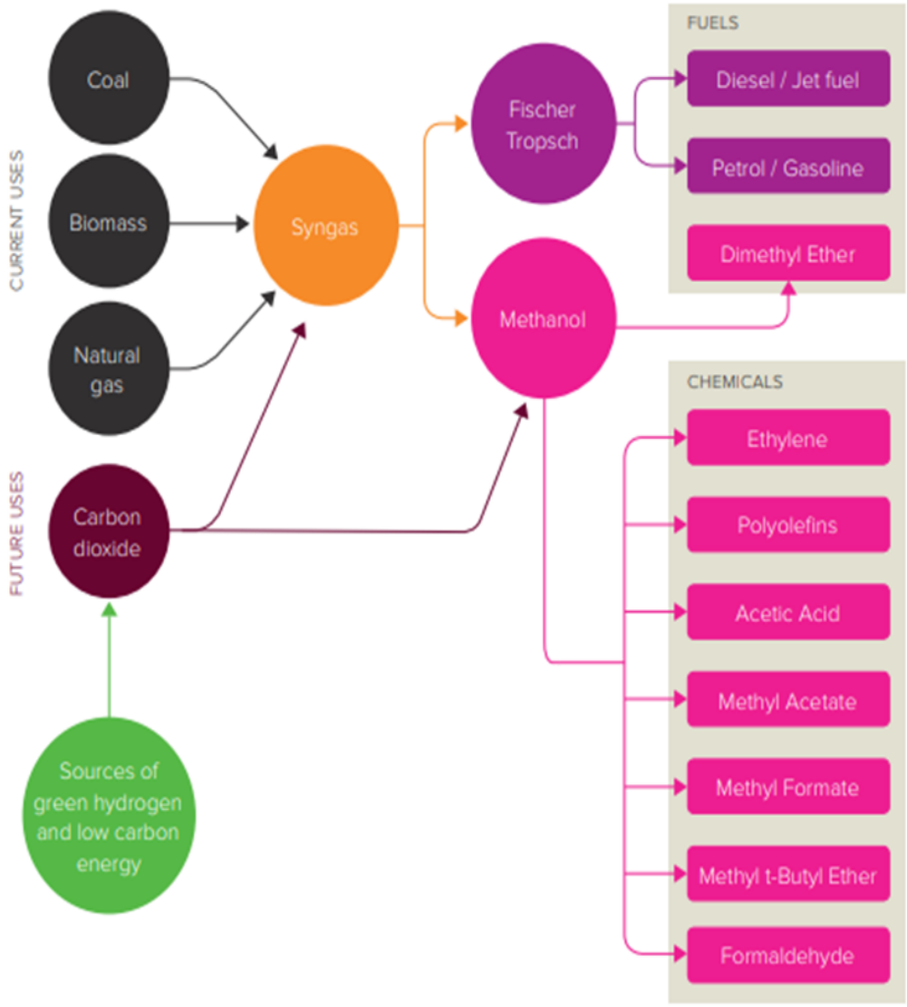
Apart from direct use of CO2, organizations are positioning themselves to become carbon neutral and even negative. Carbon reduction and removal technologies will be key to proving this a continued success.

Carbon for chemical production reduces dependence on oil and gas feedstock



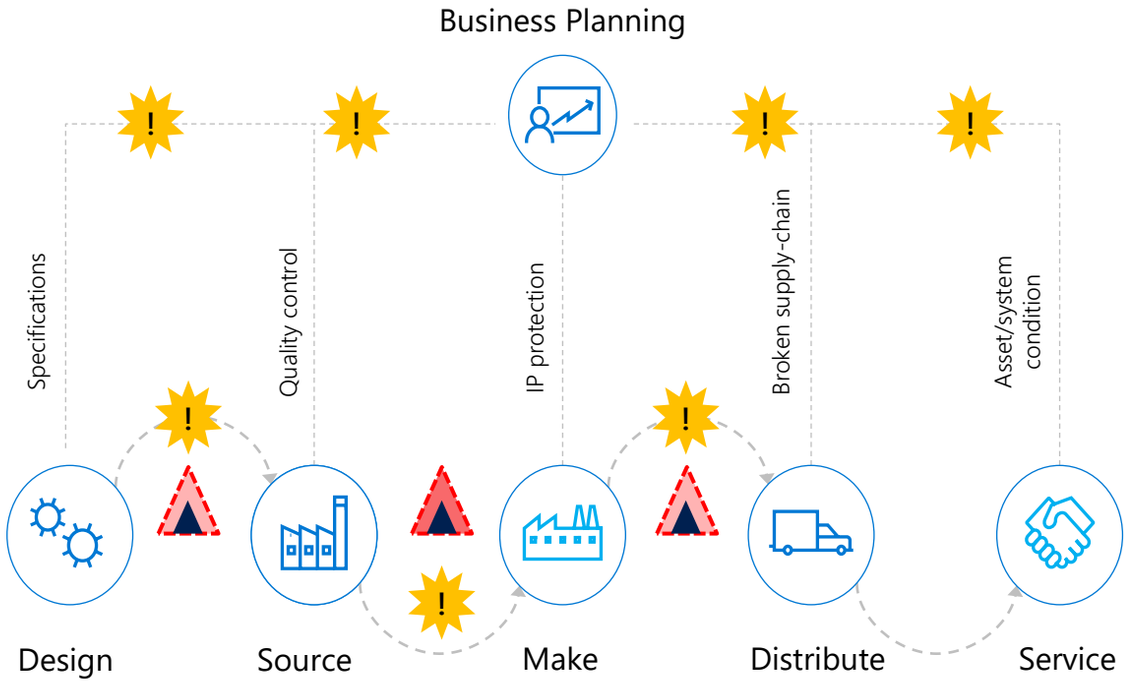
Polymers made using carbon can be produced within existing petrochemical based manufacturing facilities.

Hydrogen economy is connected to the carbon capture economy, as it is required to drive the conversion of carbon dioxide.



TREND 11: Fourth Industrial Revolution Changes the Way, We Design, Make, Source, Supply and Service

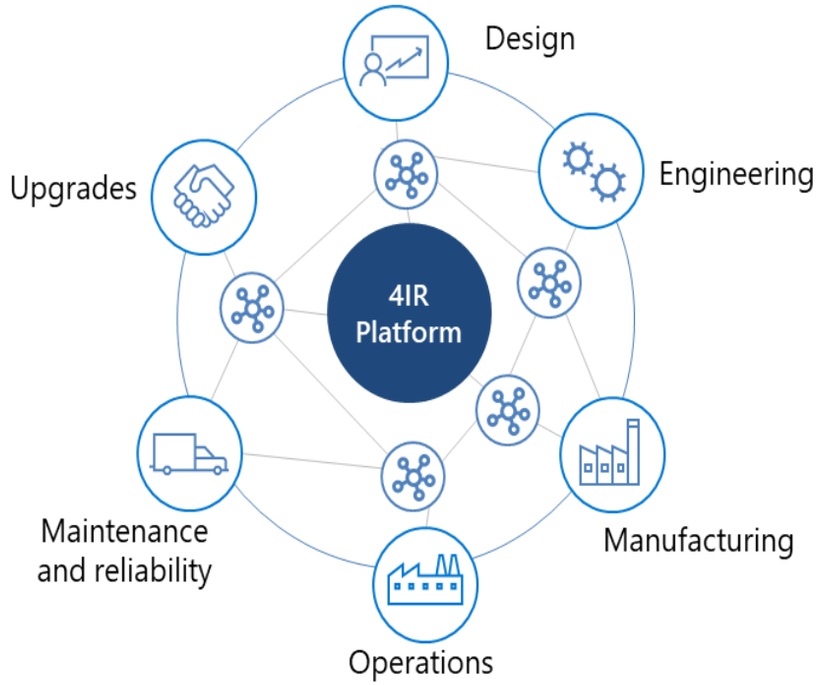
Past – Linear, Disjointed and Reactive



Data silos, reactive schedule control, poor customer centricity

Follows product, process or people	Conflicting KPI's	Unmanageable lead times	Surplus inventory

Future – Circular, Integrated and Predictive



Responsive customer-centric value-chain

Follows data	Digital tech enabled	Optimized operations	E2E view of the lifecycle

Source: Frost & Sullivan

TREND 12: Supply-chain's become demand-web's of the future

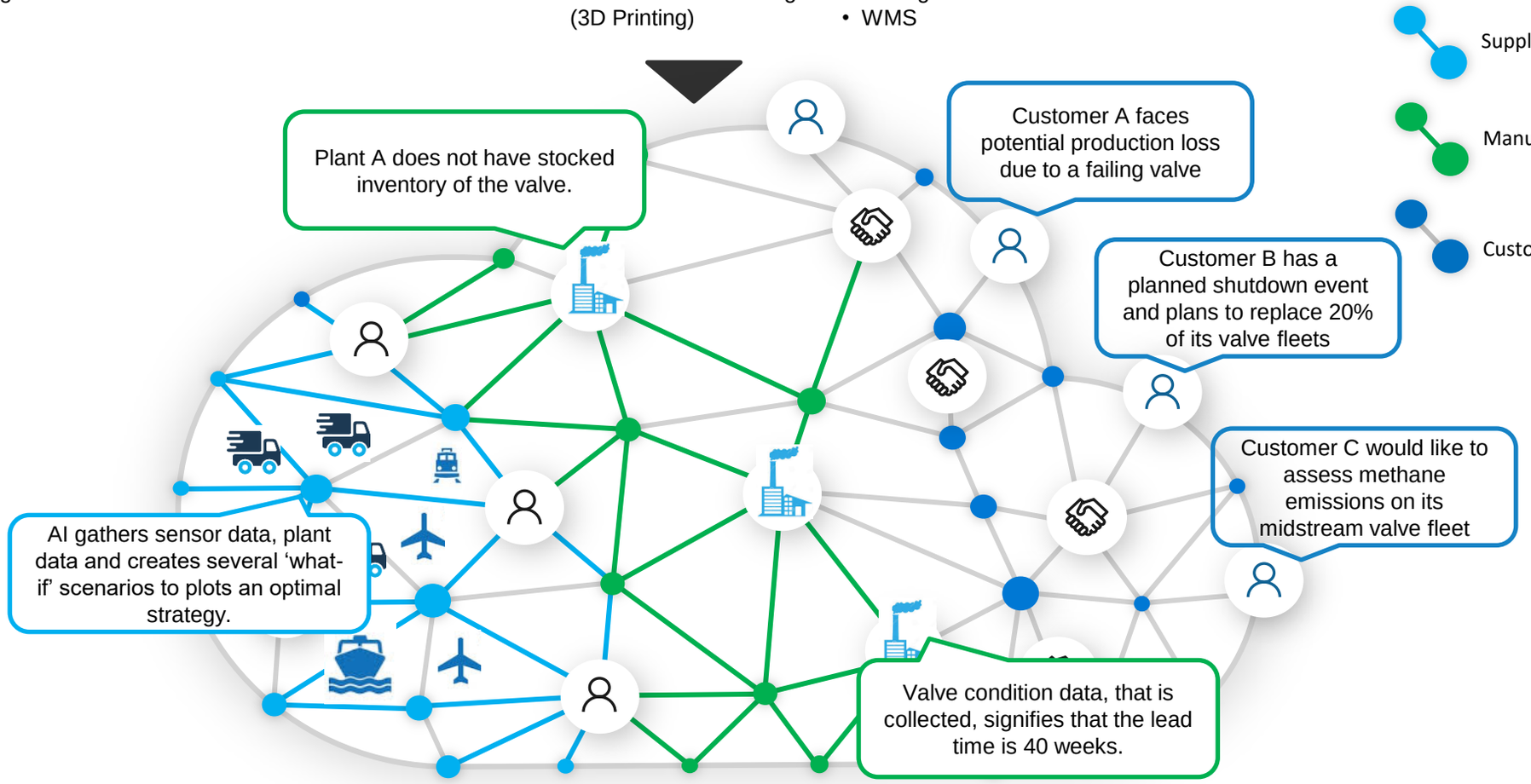
PAST

Latency-laden value-chain

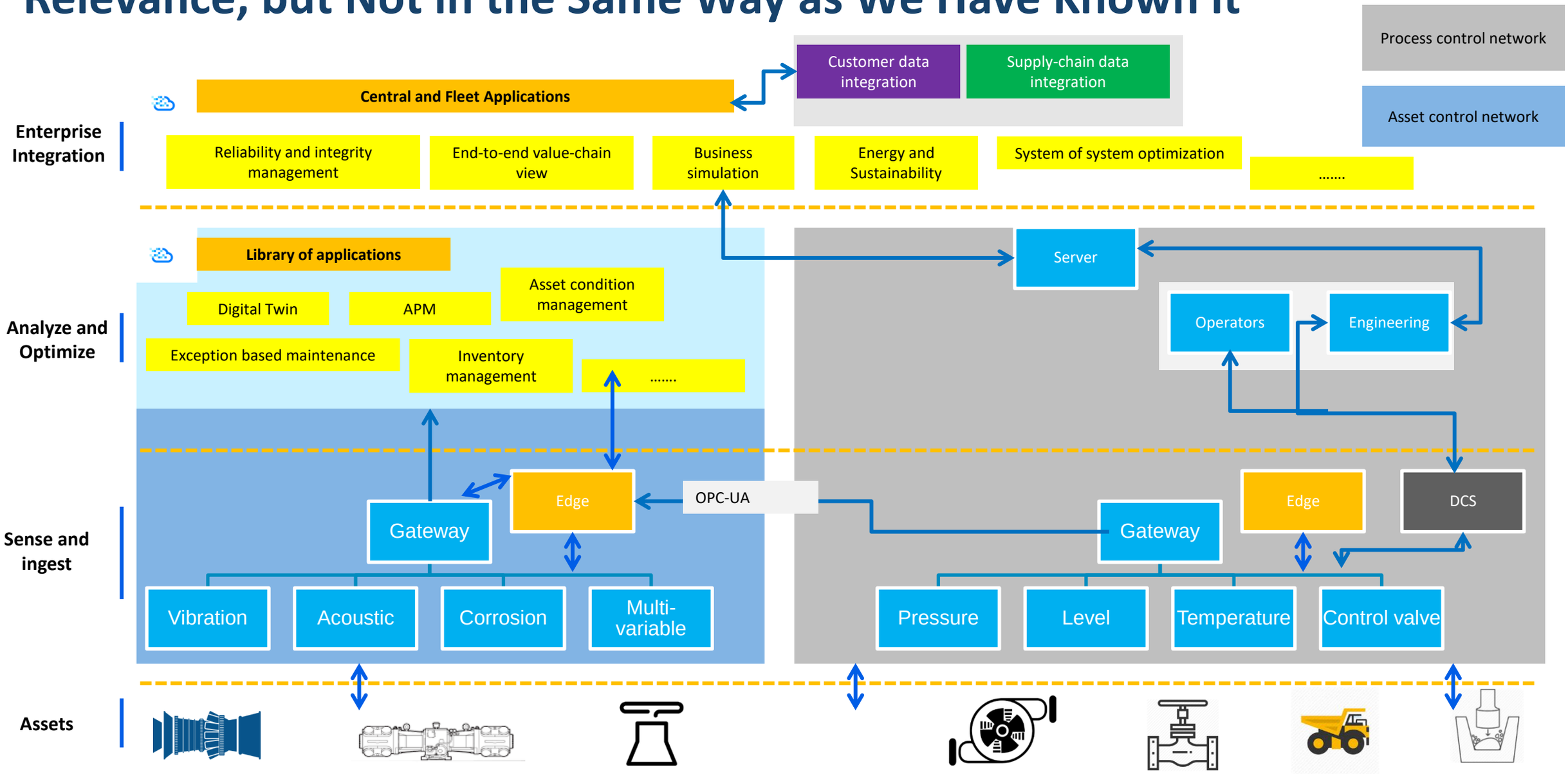
Procurement	Transportation	Manufacturing	Warehousing	Distribution	Service
• eProcurement Solutions • Vendor Management • Invoice and Payment Management	• Sensorization of Shipments and Vehicles – Real-time Tracking and Tracing • TMS and FMS	• Material Resource Planning (MRP) • Automation • Additive Manufacturing (3D Printing)	• Automation • Sensorization for Better Inventory Planning and Management • WMS	• FMS • Distributed Order Management (DOM) • TMS and FMS	• Connected services • Operational Behavior Analytics

FUTURE

Responsive and dynamic demand webs

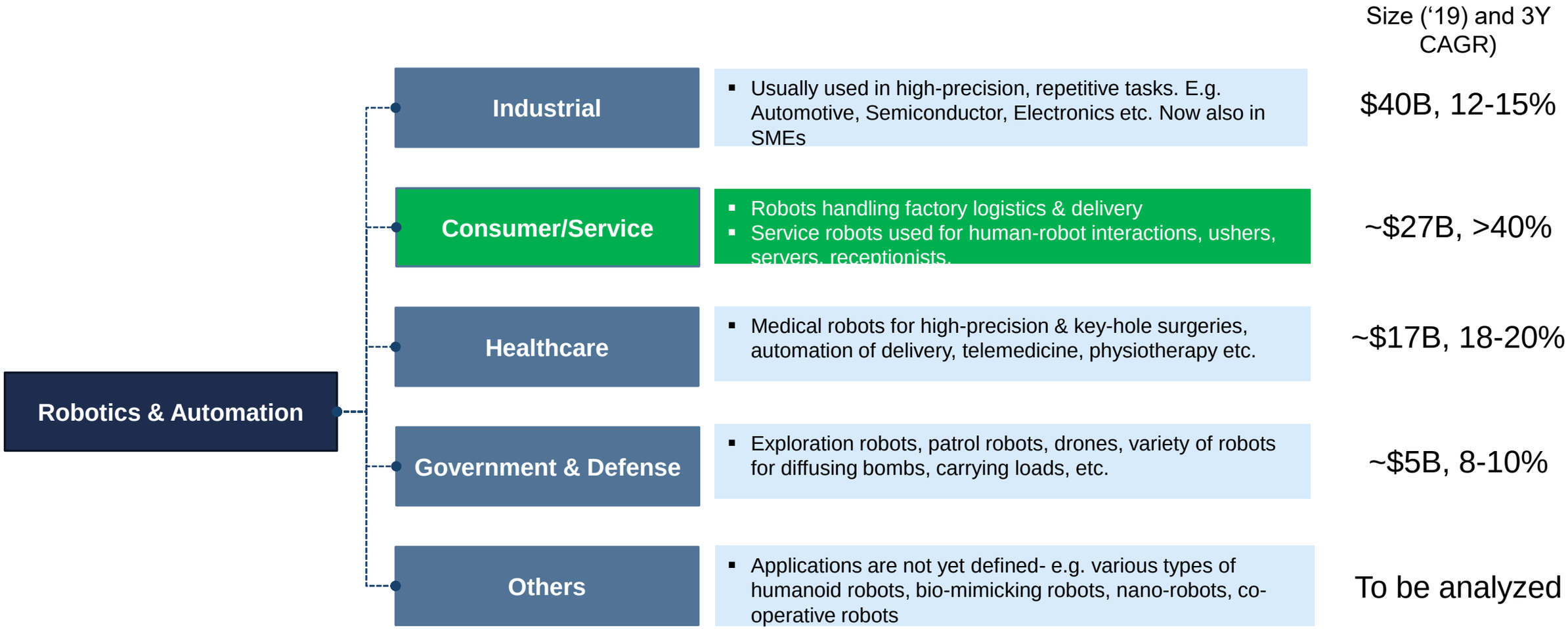


TREND 13: Edge as the Compute Platform of Choice. DCS Maintains Relevance, but Not in the Same Way as We Have Known it



TREND 14: Robotics as a Growth Platform

Global robotics market is ~89B, with exponential offtake across end-markets. Industrial, healthcare and service robots will are top three sectors, with service robots growing the fastest.



Source: Frost & Sullivan. CAGR’s may vary, considering the dynamic situation

FROST & SULLIVAN

04. Customer Trends

Critical issues and customer transformation

96 Critical Issues Across 14 End-markets

	Observed Industry Specific Critical Issues Across Process, Hybrid and Discrete Driven Industries						
Oil and Gas Upstream and Midstream	4IR (AI, Production Automation, Additive Manufacturing, Blockchain, Edge Computing)	Energy transition (De-carbonization, Methane emissions, Carbon capture, Hydrogen energy)	Seismic mapping (High performance computing, smart downhole sensors)	Natural gas monetization (LNG, CNG, GTL)	Data engineering, management and sharing	Skilled workforce Shortage	Cybersecurity implementation
Oil and Gas Refining	Centralized/above site management	Dynamic environmental regulations	Optimization performance of industrial base assets	Integrated DCS platform management	Cybersecurity implementation	Skilled workforce shortage	Data engineering and optimization
Chemicals and Speciality Chemicals	Feedstock cost management and dynamic sourcing	Product quality, monitoring and management	Asset performance management	Operational intelligence and analytics	Value-chain optimization	Transition to a circular economy	Cybersecurity implementation
Power Generation	Reducing Start-up times for conventional operators	Longer mean times between asset turnaround cycles	Cybersecurity implementation	Environmental Compliance	Skilled workforce shortage	Data engineering and optimization	Value-chain portfolio optimization
Water & Wastewater	Lack of importance and investment in digital solutions	Treatment efficiency	Skilled workforce shortage	Cybersecurity implementation	Water Scarcity	Value-chain portfolio optimization	Data engineering and optimization
Metals and Mining	Production cost management	Workforce safety and security	Environmental compliance	Mining equipment reliability	Digital autonomy in mining equipment	Transition to a low carbon economy	Enterprise Data Management
Life Sciences	Time-to-new drug development	Siloed legacy systems	Reduction of waste	Inaccurate demand visibility	Skills shortage	Lack of digital modernization	Cost & feasibility management
Food & Beverage	Digital modernization of existing plants	Resource (water, energy) efficiency optimization	Direct manufacturing-to-consumer channel shift	Compliance and traceability	Data engineering and management	Supply-chain resilience	Machine uptime management
Pulp and Paper	Navigating Grade Turbulence	Balancing costs and efficiency with digital solutions	Cybersecurity implementation	Environmental Compliance	Reduction of Waste	Circular economy transition	
Automotive	Flexibility and Velocity in throughput	Maintaining consistent product quality	Managing recall volumes	Data management across value-chain	Simulation (AR/VR for efficiency management)	Supply network visibility	Value-chain traceability
Aerospace and Defence	Highly cohesive, low friction data technology stacks architecture	Digital continuity, simulation and virtual reality integration	Supply network resilience management	Cybersecurity implementation	Advanced robotics Implementation	Cognition Implementation	Driving alternate revenue streams
Electronics	Shrinking Operating Margins	Complex Global Supply-Chain	Service and Warranty Management	Short Product Lifecycle Management	Demand Ready Manufacturing	Circular economy transition	Data engineering and optimization
Semiconductors	Visibility on end-to-end supply chain	Cost reductions vs product performance and quality	Accelerated implementation of new digital technologies	Reduction of waste, shift to circular economy	Skills shortage	**Cybersecurity implementation**	
Machinery	Aging workforce leading to skills shortage	Maintaining product quality and workforce safety	Sluggish demand from mature markets	**Cybersecurity implementation**	Data engineering and optimization	Supply Chain Traceability	Circular economy transition

Observed Cross Cutting Critical Issues across Process, Hybrid and Discrete Industries					
Digital Transformation Origination To Business Value Conversion	**Environmental Compliance, Sustainability, Circular Economy**	**Data Engineering, Management and Insights Derivation**	**Skilled Workforce Shortage**	**Value Chain Traceability and Optimization**	**Cybersecurity implementation**

Customer Use Case 1: ENI Becoming New Zero by 2030

Eni's circular transformation began Downstream with the refining sector. **They were the first to convert a traditional refinery into a bio-refinery through the use of our proprietary technologies**. The **transformation has also involved the waste-to-energy sector**, thanks to proprietary waste-to-fuel technologies, and the chemical industry, in which they are studying and creating new processes and products – giving **value to waste plastics by converting them into secondary raw materials**.

CORE BUSINESS

UPSTREAM

LNG

DOWNSTREAM

NEW GREEN BUSINESS

RENEWABLES

CIRCULAR ECONOMY

FORESTRY

Increased Efficiency

New Products (from organic and inorganic waste)

Growing Share of Gas

Growth in Zero Carbon Sources

CCUS(Carbon, Capture, Utilization and Storage)

Natural Climate Solutions

NEW TECHNOLOGIES

Source : ENI & Frost & Sullivan analysis

Customer Use Case 2: Equinor's Digitalization Initiatives

>400

Million USD

Improvement impact 2019

50% increase

>3

Billion USD

Cash flow improvement 2020-2025

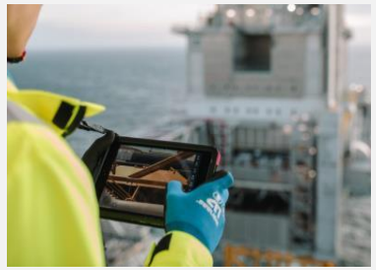
"TRUE POWER OF EFFECTIVE DIGITALIZATION"

Operation centres

- Offshore assets
- Unconventional assets
- Geo-operations
- Drilling & well

>20

Assets connected to integrated operation centres



Data driven operations

- Digital field worker
- Digital twin – Echo
- Operational planning
- Drones and 3D printing

>20

Assets supported by new digital solutions

Subsurface analytics

- Subsurface data lake
- Reservoir experience platform
- Well analytics

>50

Assets with digitalized subsurface data

Digital drilling & well

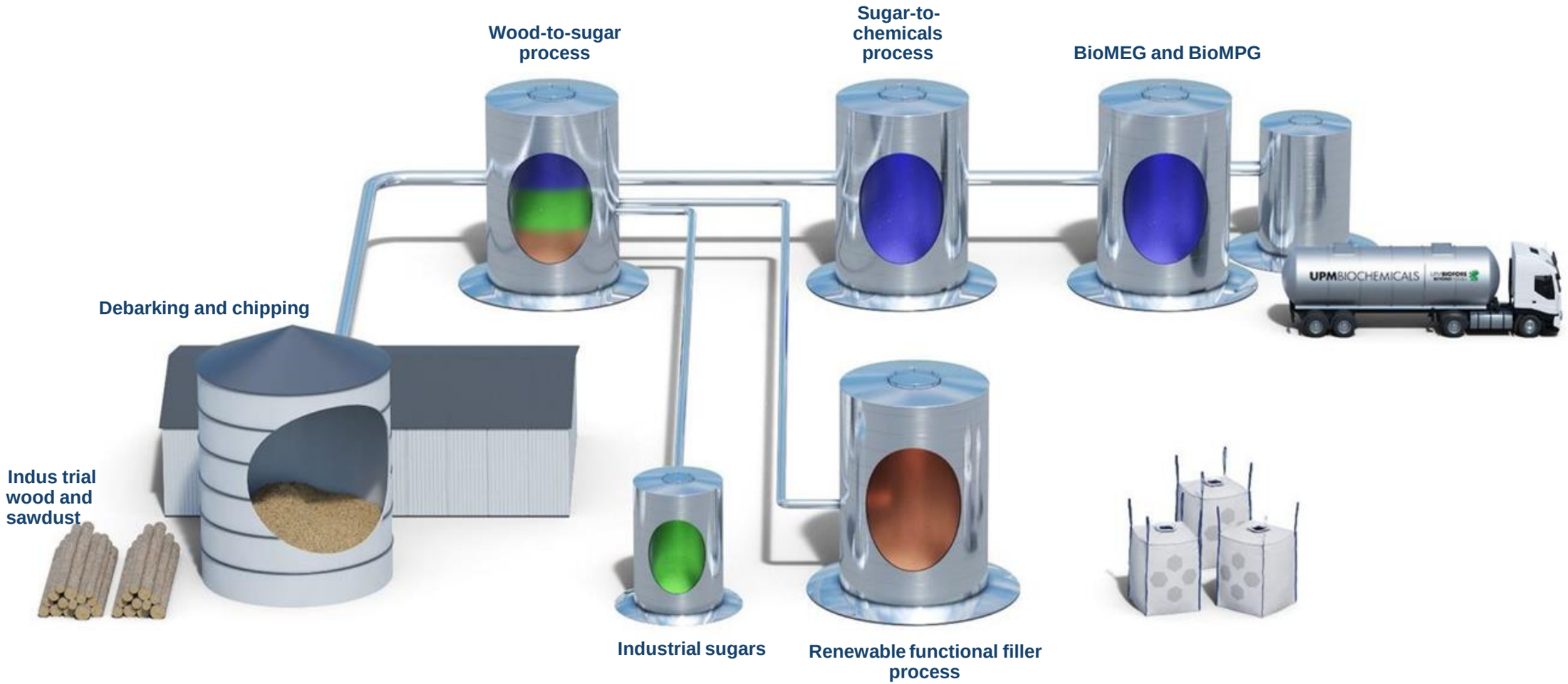
- Automated drilling control
- Well planning

13

Mobile rigs with automated drilling control

Source : Equinor and Frost & Sullivan analysis

Customer Use Case 3: UPM's Biochemicals from Wood Processing



"Our wood-based renewable biochemicals offer sustainable and competitive **high-quality solutions for replacing fossil-based raw materials.** Our responsibly sourced renewable lignin is already in use across various industries and applications. Moreover, we will invest in a new-to-the-world industrial scale bio refinery at Leuna, Germany. The bio refinery will convert solid wood into next generation biochemicals: bio-monoethylene glycol (BioMEG) and lignin-based renewable functional fillers. In addition, the biorefinery will produce bio-monopropylene glycol (BioMPG) and industrial sugars. The facility is scheduled to start up by the end of 2022. " – **CEO, UPM**

Source : UPM

Customer Use Case 4: VOPAK's OT/IT Integration

SUMMARY

Vopak's focus on technology leadership is to enable the organization store vital products with care.

Some of the key digital initiatives include:

- Predictive maintenance for motor operated valves
- Energy management initiatives
- Cost-effective sensoring
- Digitizing whole terminals in multiple dimensions.
- Simplification of the tech stack

CHALLENGES AND TECH IMPLEMENTATION

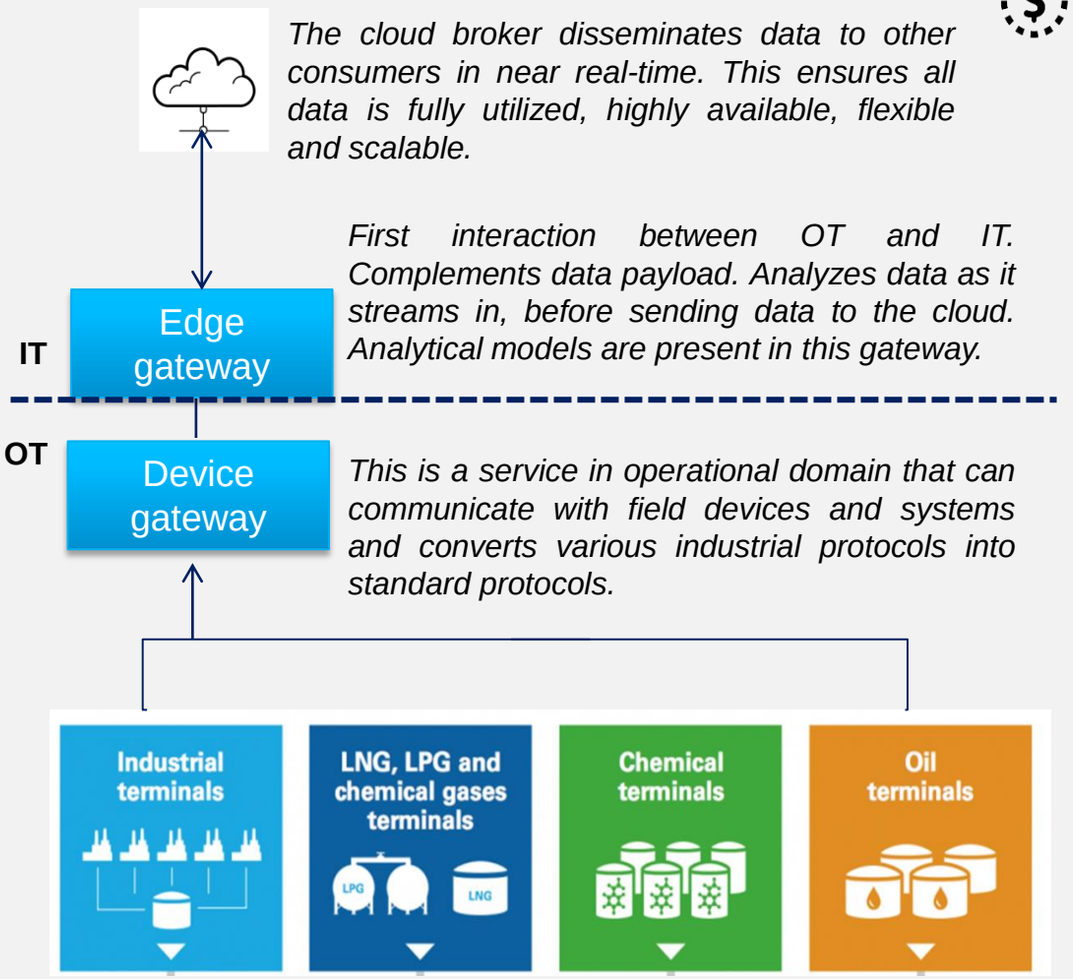
Data with context

- Access operational data with the context in which the data is generated.
- Limit cloud communication, by pre-processing, aggregating and filtering operational data.

Protocol agnosticism

- Industrial protocols like MODBUS, OPC-UA classic are not best suited for modern business application and IT landscapes
- Balancing availability, communication speed and Cybersecurity

Simplified OT/IT architecture and tech stack



OUTCOMES

Standardized Data

Device and edge gateways are placed in all terminals, which uses open and industry standards to expose field data in a highly standardized manner).

Edge Power

Instead of using ISA-95 architecture, VOPAK utilized a simple architecture to enable high customization at the edge. It also leveraged off-the-shelf services to homogenize the heterogeneity in protocols.

Customer Use Case 5: A Middle Eastern O&G Organization's Digitalization Initiatives

Digital Centers

Has established state-of-the-art Technologies through multiple Digital Centers in its Premises. These Command & Decision Support Centers enabled to strengthen their Digital "ThinkTank", to add more value to aspects of : Operations, Development, Production & Engineering.

Digitization of Subsurface Activities

- Reservoir Rock classification Data Driven Reservoir Model for Production Optimization
- AI Guided Seismic Interpretation
- Well enhancement Opportunities Identification

Drilling REAL-TIME MONITORING CENTRE

- Access to all data to set clear Benchmark and KPIs
- Analyze and investigate performance
- Set action plans for improvement
- Better visibility for all the wells in Abu Dhabi under one system

Robotics & Drones: For Inspection & Monitoring

- Advanced Inspection with Drones for Flare & H2S
- Robotics use for Walk around & operation safety
- Unmanned Field of the Future

Data Integration

- Power Network
- Main Parameters
- Plants and Pipelines
- PMC Dashboard

ERP Data

- HR Data
- Finance
- Inventory
- Historical Maintenance

PANORAMA: THE GATEWAY TO DIGITAL TRANSFORMATION

Panorama represents a single source of accurate information across value chain

Customer Use Case 6: A European Chemicals Organization Digital Transformation Initiative

Digital Programs

Programs	Digital Customer	Digital Site	Digital Plant	Digital Worker	Digital Supply Chain
Objectives	End-to-end digital customer interface	Omnipresence of site services accessible by customers and employees	Efficient manufacturing through automation and data integration	Digital equipment for employees	Seamless digital connection for flow of material & information
Enabler	New ways of working: organization, qualification, and communication				
	IT-Architecture: vertical integration, IIoT platforms and security				

Allocation of € 100 million for

- Development & testing of digital technologies
- Development of digital skills
- New business models

To benefit from the latest technologies such as:

- Cognitive Manufacturing
- Blockchain
- Analytics
- Quantum Computing

Customer Use Case 7: Factory 56 — Modern Car Production

3 Main Objective

1. Digital & flexible
2. Green production
3. Using Advanced Technologies

Start production **2020**

Type **Luxury-class & electric vehicles**

360 degree linkage along whole value chain

Advanced Technologies

State-of-the-art Assembly Hall

- Driverless transport systems (DTS) with product baskets
- RFIDs integrated into the "Factory 56“ Components

Quality Assurance

- Artificial Intelligence, Big Data analyses and Predictive Maintenance guarantee high transparency

Sustainable and Energy-efficient

- Use of renewable energies: photovoltaic system on roof— reduction of yearly 5,000 MWh of electricity
- Reduced CO2 production, water consumption and waste

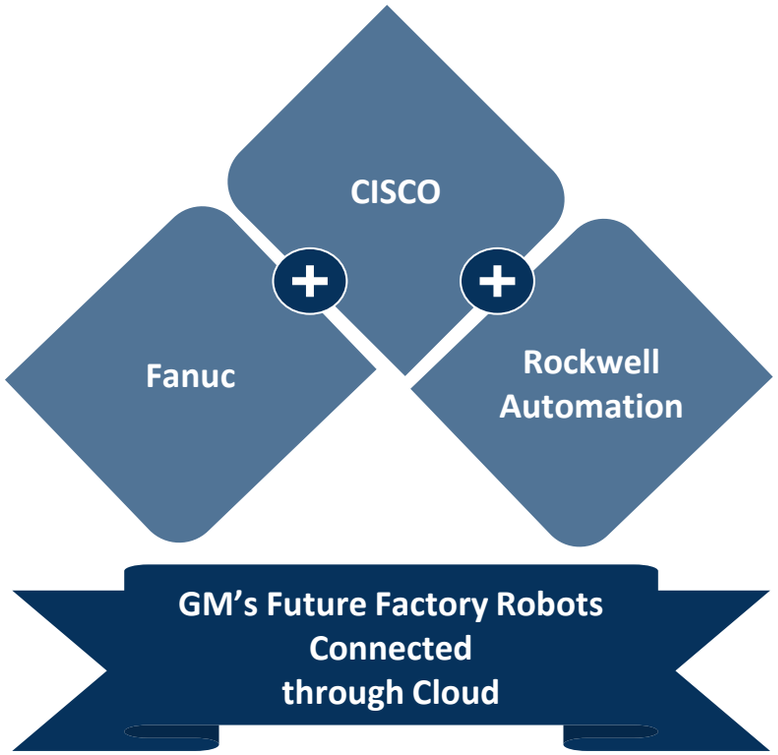
Design — **Development** — **Production** — **Suppliers** — **Customers**

Customers gain exclusive insights into the production — have more enjoyable wait for delivery

Customer Use Case 8: GM IIoT Initiatives- Pilot Project to Reduce Factory Downtime

GM factories will leverage a combination of IIoT with data from sensors and data analytics all enabled by cloud technology to reduce unplanned downtime.

Partnership



GM leverages **Cisco Intercloud Fabric**, robotics manufacturer **Fanuc ZDT** and hardware maker **Rockwell Automation** to collect data from 800 robots and external devices and send it to a cloud network setup by Cisco for further analysis primarily to reduce downtime.

Challenges

- Unplanned downtime costs: **$15,000–$40,000** per minute
- Factory workers often learn about issues with their production machinery too late – after the line shuts down.

Solution Approach

Fanuc uses algorithms that have been tailored to factory robots to create insights for GM.

Fanuc's Zero Down Time (ZDT) application collects data generated from robots to determine optimization approach of GM's manufacturing systems by reducing energy consumption, extending equipment life, and improving cycle time and product quality.

GM will leverage cloud based IoT analytics to factories across the globe in the next 5 years.

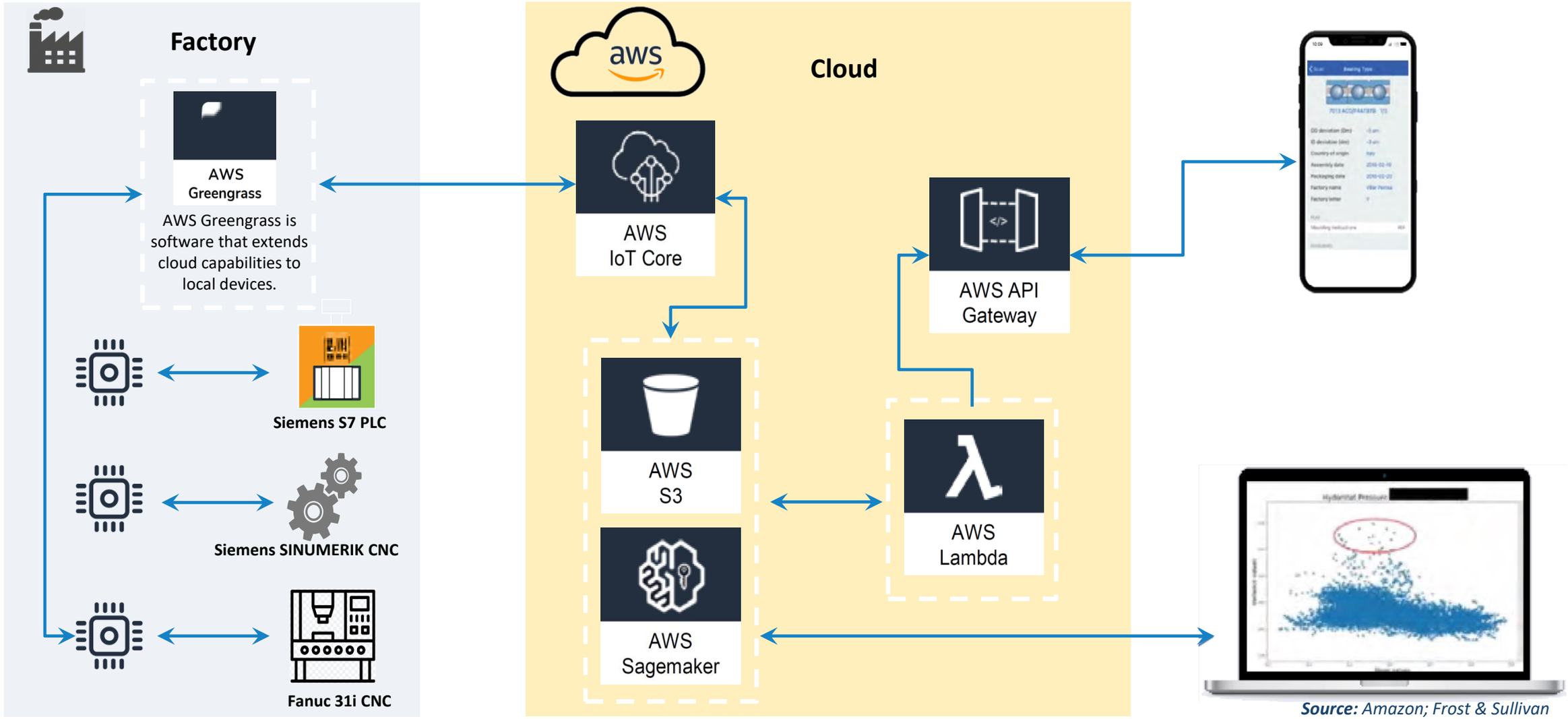
Business Impact

- GM has deployed ZDT in **27 factories** in **5 countries** analyzing over **5,000** robots
- ZDT has successfully detected over 45 cases of potential failure across 26 production plants over the past year and saved already customers ***$40 million***

Customer Use Case 9: SKF Optimizes Production Processes Using AWS Cloud

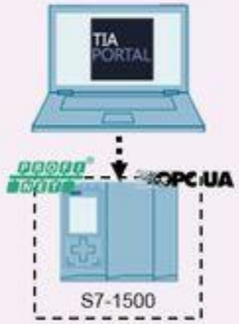
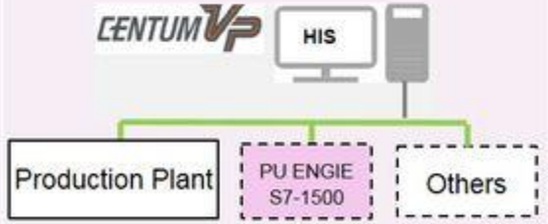
Using AWS, SKF is optimizing its production processes, reducing costs, and providing a better experience to its customers

SKF is a bearing manufacturer founded in Sweden in 1907. SKF uses AWS machine learning, data lakes, databases, and more to help it speed innovation.



Source: *Amazon; Frost & Sullivan*

Customer Use Case 10: Evonik's MTP Use for Efficient Automation Integration

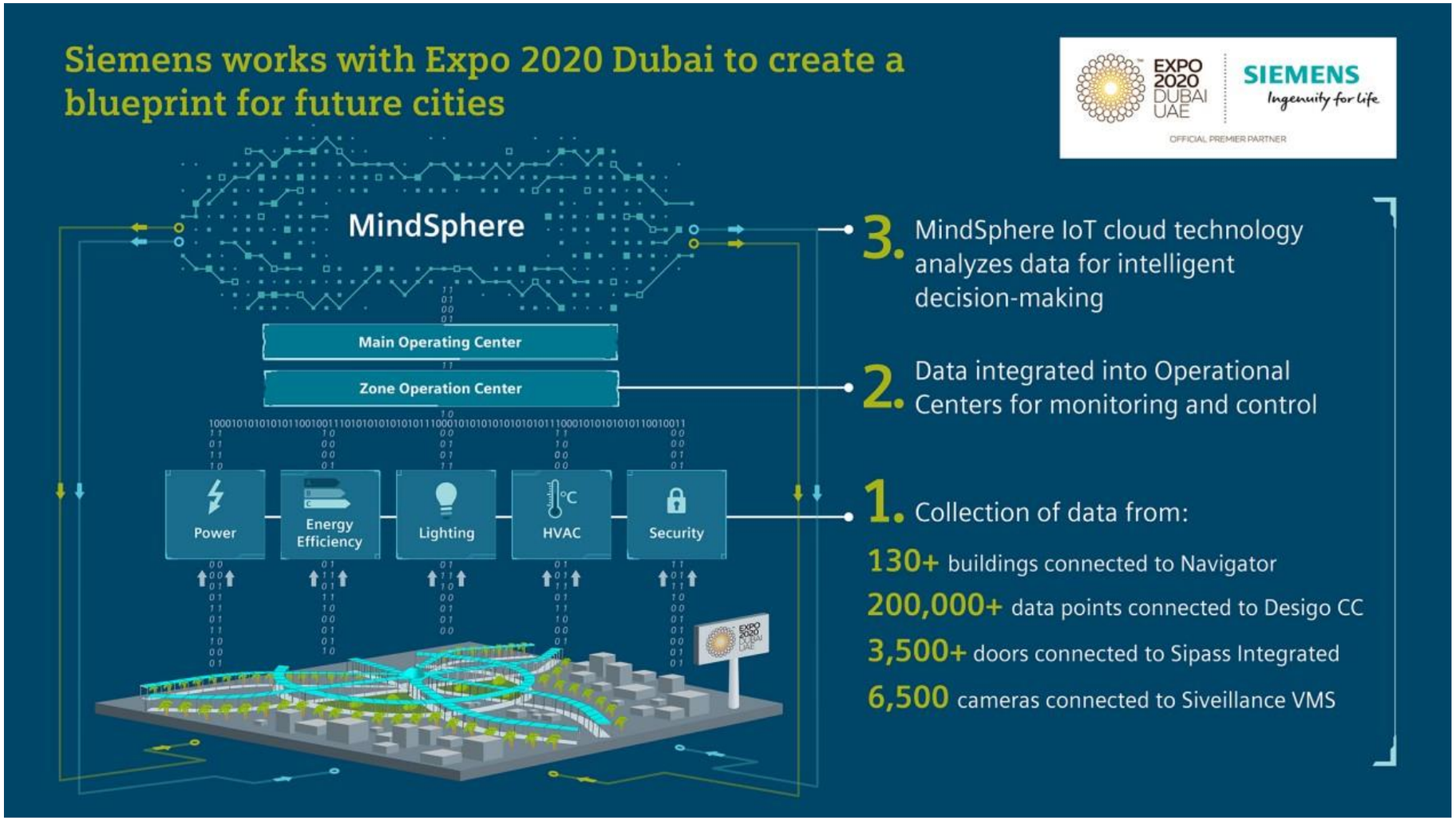
ENGIE	Siemens	Yokogawa	Evonik
Module Supplier Package Unit	**Module Automation Engineering**	**Plant Automation Engineering**	**Plant Integrator End User**
Cooling Machines	PLC S7-1500	DCS Centum VP	Evonik Site
			

The chemical industry today faces the **challenges of producing more flexibly and with a faster time-to-market**. It is therefore **necessary to increase the requirements for automation systems such as interoperability and standardization**. Modular automation offers a suitable solution for these challenges. The integration via the MTP reduces the manual effort and thus saves time and costs.

Source: *Evonik, Frost & Sullivan*

Customer Use Case 11: Expo 2021 Dubai, by Siemens

The core of the digital infrastructure is MindSphere, the open, cloud-based IoT operating system from Siemens. Data from sensors, gateways, systems and building management applications is gathered in MindSphere, where it can be analyzed and visualized by applications such as Navigator, the cloud-based energy and asset management platform from Siemens.



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The Growth Pipeline™ Company

Powering clients for a future shaped by growth