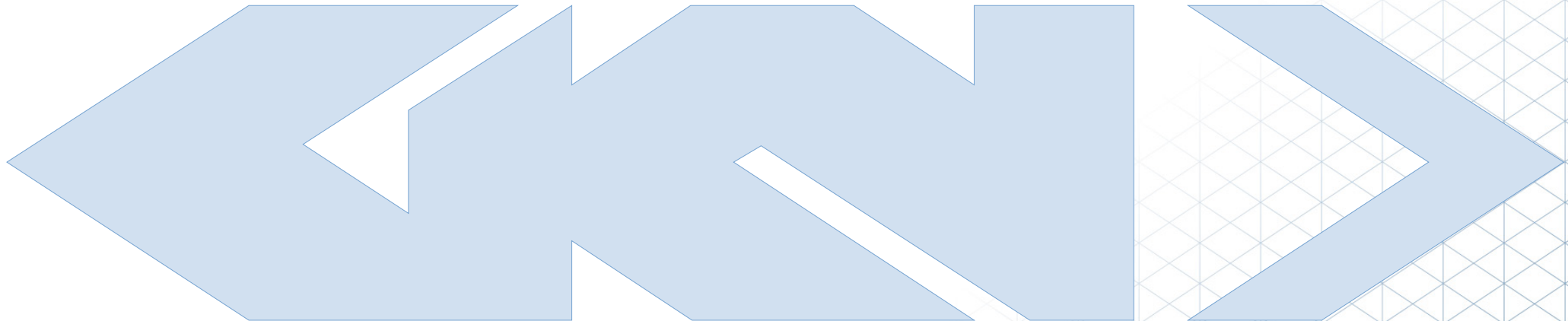




Digital Transformation in the Aerospace Manufacturing Industry

French-Norwegian Learning Expedition, Toulouse

Ole B. Hoen | 20.11.2019



The information in this presentation is proprietary and confidential and shall not be disclosed to or used by a third party unless specifically authorised by the relevant GKN Aerospace company.



Agenda

Introduction

The global changes in aerospace

The challenges

The way forward



Ole B. Hoen, M.Sc. Eng.

Vice President Center of Excellence and Research & Technology

GKN since 2001

Various positions over the years

Board member Federation of Norwegian Industry's association for technology companies



GKN Aerospace: A leading global tier 1 Aerospace supplier

Strong focused businesses, sales £3.53 billion (2018), 18,500 employees.

Aerostructures
63% - £2.2bn



Engine Systems
32% - £1.1bn



Special Technologies
5% - £0.2bn





Widest capabilities of any Tier 1

AEROSTRUCTURES



- > Fuselage, wing, nacelle & pylon
- > Inflight opening doors and empennage (tails)

GLOBAL NO. 2

ENGINE SYSTEMS



- > Static & rotating structures
- > Titanium engine inlet parts

GLOBAL NO. 2

SPECIAL PRODUCTS



- > Transparencies
- > Ice protection systems
- > Flotation devices
- > Fuel tanks

GLOBAL NO. 1

WIRING INTER-CONNECT SYSTEMS



- > Electrical Wiring Interconnection Systems (EWIS) for aircraft & aircraft engines

GLOBAL NO. 3

LANDING GEAR



- > Helicopter landing gear
- > Composite load carrying landing gear components (drag brace)

GLOBAL BRAND

GLOBAL SERVICES



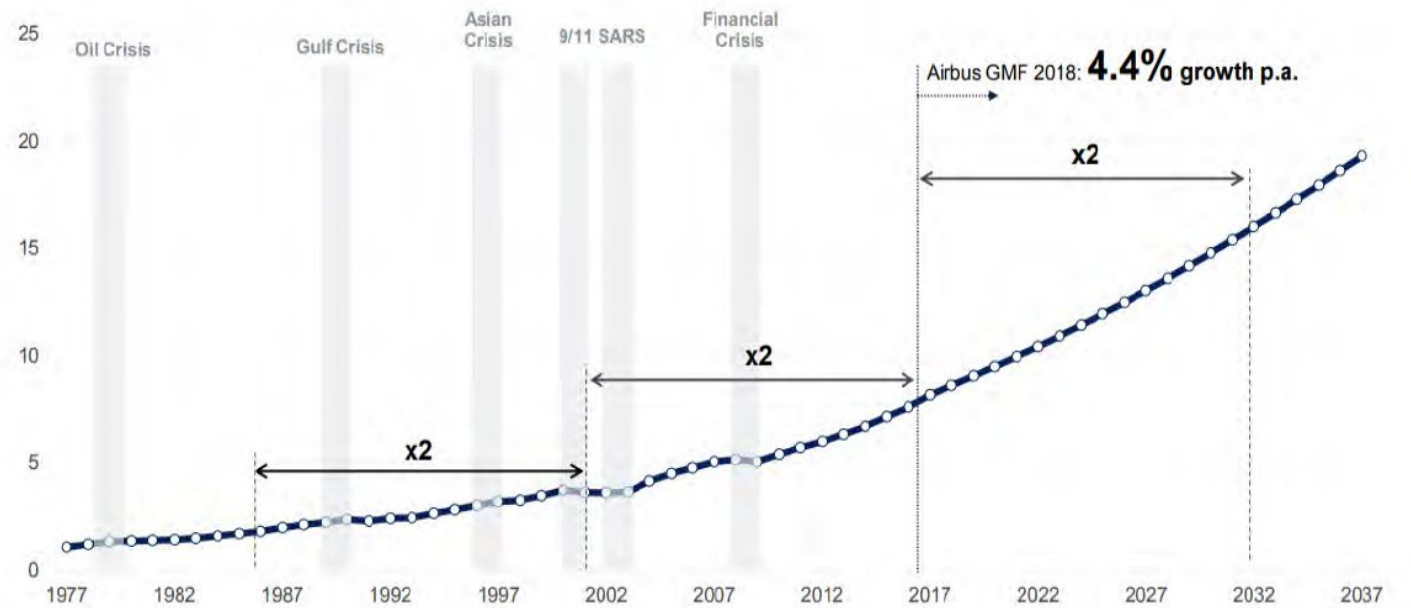
- > Availability services, MRO, conversion and completion for mature and legacy aircraft

GLOBAL BRAND

The global changes

Flight traffic expected to grow 4,4% p.a.

World annual traffic (trillion RPKs)



5

RPK = Revenue Passenger Kilometre
Source: ICAO, Airbus GMF 2018

AIRBUS

* Courtesy Airbus: GMF 2018 - 2037

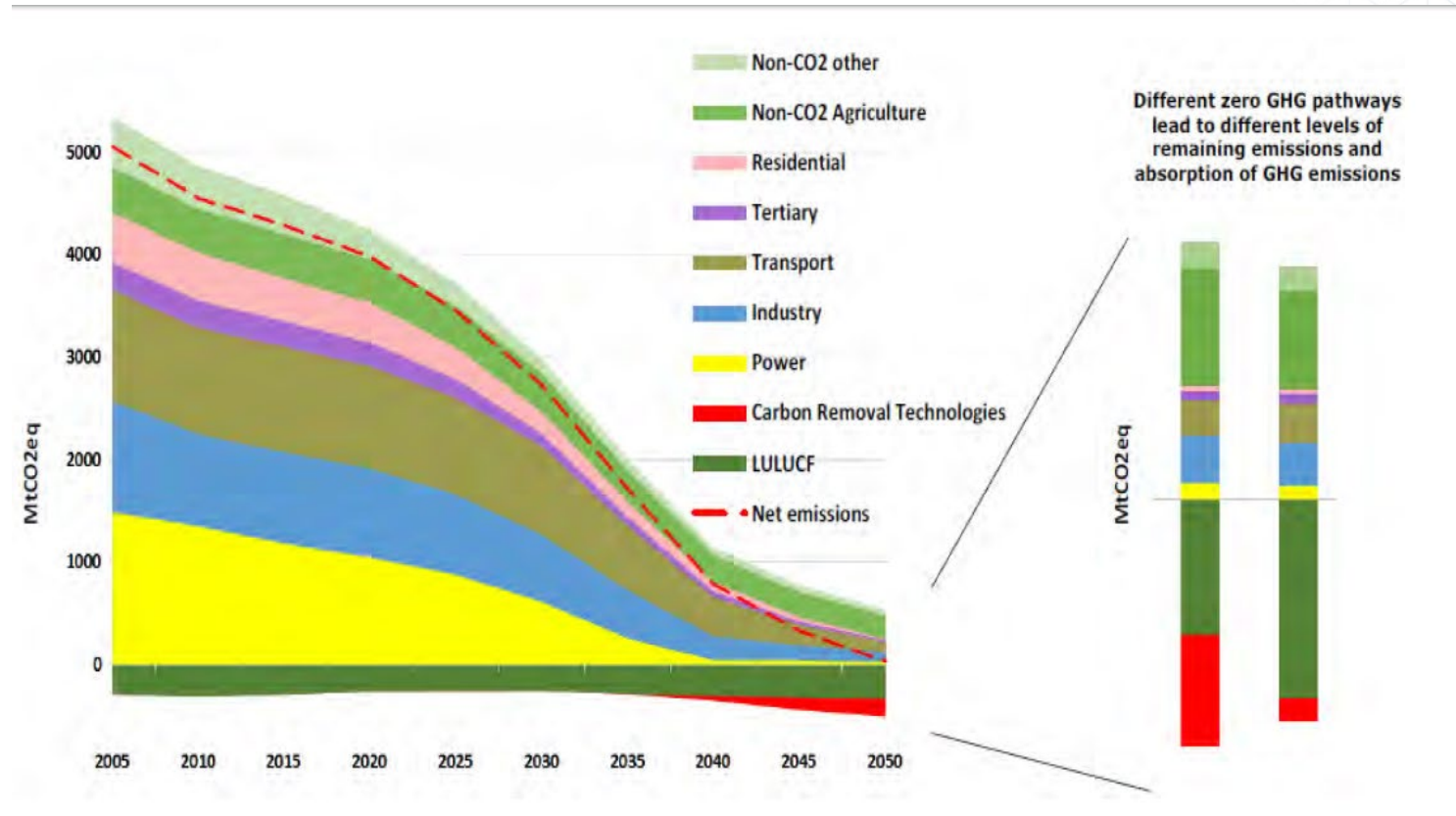
The global changes

Flight traffic expected to grow 4,4% p.a.

Environmental care:

EU's ambition: net carbon free by 2050

ATAG: carbon neutral growth from 2020



EU CO₂ reduction target of at least 80% in 2050 vs. 1990

The global changes

Flight traffic expected to grow 4,4% p.a.

Environmental care:

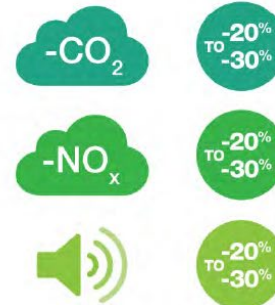
EU's ambition: net carbon free by 2050

ATAG: carbon neutral growth from 2020

Noise reduction

Tackling key environmental challenges

Environmental Objectives*



* vs today's best aircraft



While building industrial leadership and ensuring mobility



Source Clean Sky 2





The challenge

Large growth in no of aircrafts

Commercial aircraft demand 2018-2037 – 42,730 deliveries¹



¹ Boeing Commercial Market Outlook 2018-2037

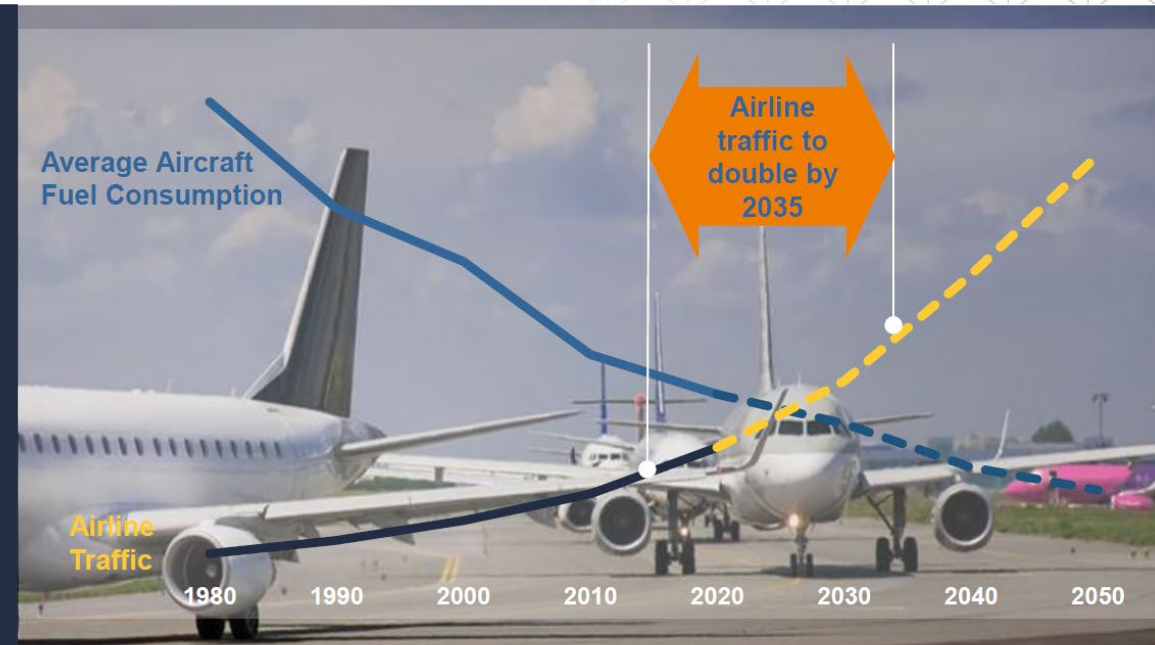
The challenge

Large growth in no of aircrafts

Traditional technology not in-line with environmental care

TODAY
200,000,000
Tonnes of Fuel
every Year

Increasing by
5% each year,
or 10,000,000
tonnes



The challenge

Large growth in no of aircrafts

Traditional technology not in-line with environmental care

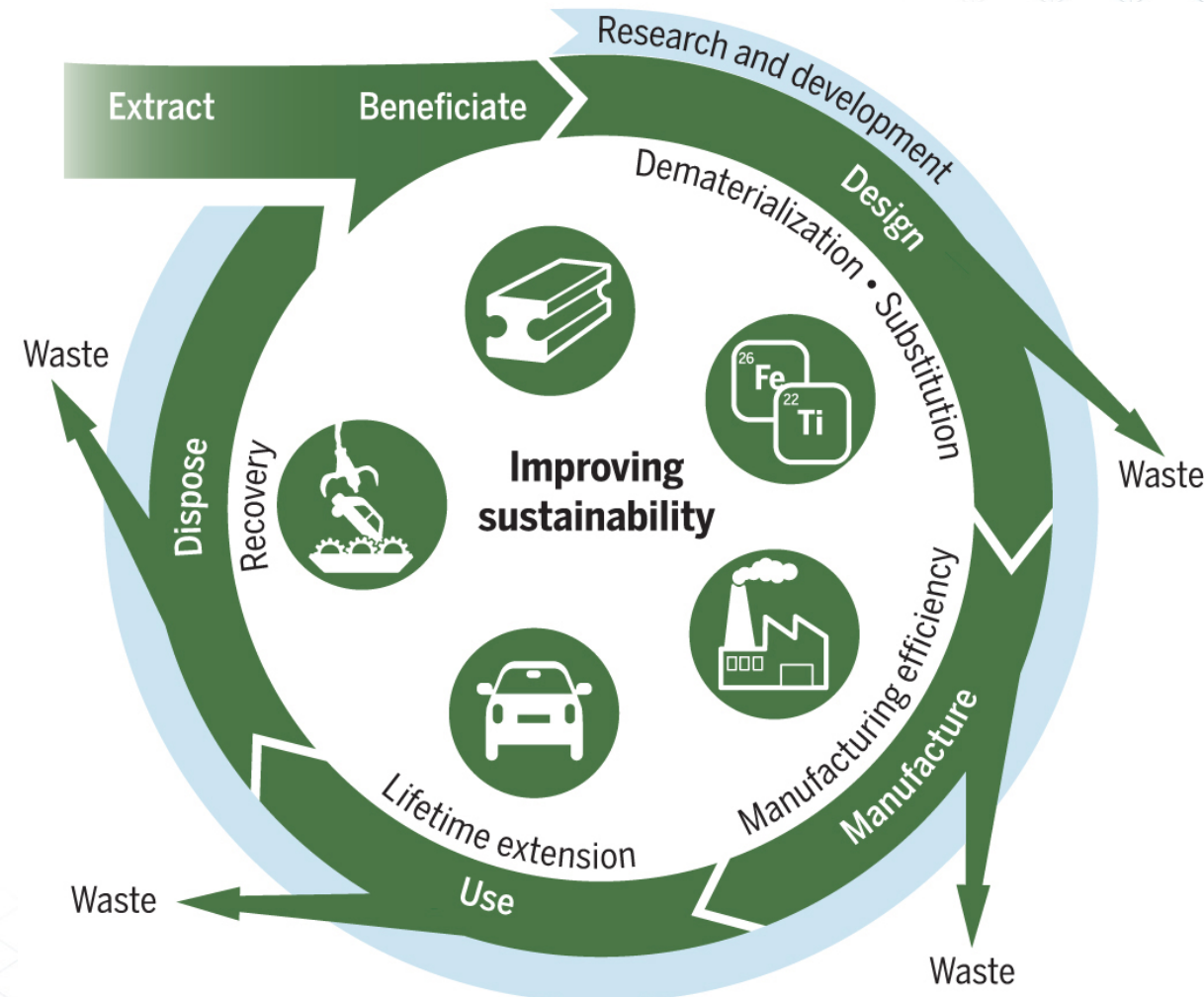
Radical changes needed in the total life cycle:

Raw materials

Manufacturing processes

Operations

Recycling and reuse



The challenge

Large growth in no of aircrafts

Traditional technology not in-line with environmental care

Radical changes needed in the total life cycle:

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Operations

Recycling and reuse

Unexpected competitors



NOKIA

The way forward

Lightweight technology



Market Needs



Reliable
Delivery

> Lead time and availability
of Major Forgings /
Castings

> Scalability for rate



World Class
Quality

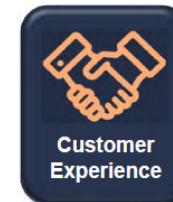
> Full control of material &
process → monitor quality
into the material



Cheaper
parts

> Significant buy to fly improvements

> Reduced material & machining



Customer
Experience

> Collaboration with customers on
product & process



Burn Less
Fuel

> Optimizing material & design for
reduced weight.

> Enabling functional optimization
Electrification

The way forward

Lightweight technology

New aircraft technology will change the traveling the pattern

Short hauls with small aircrafts

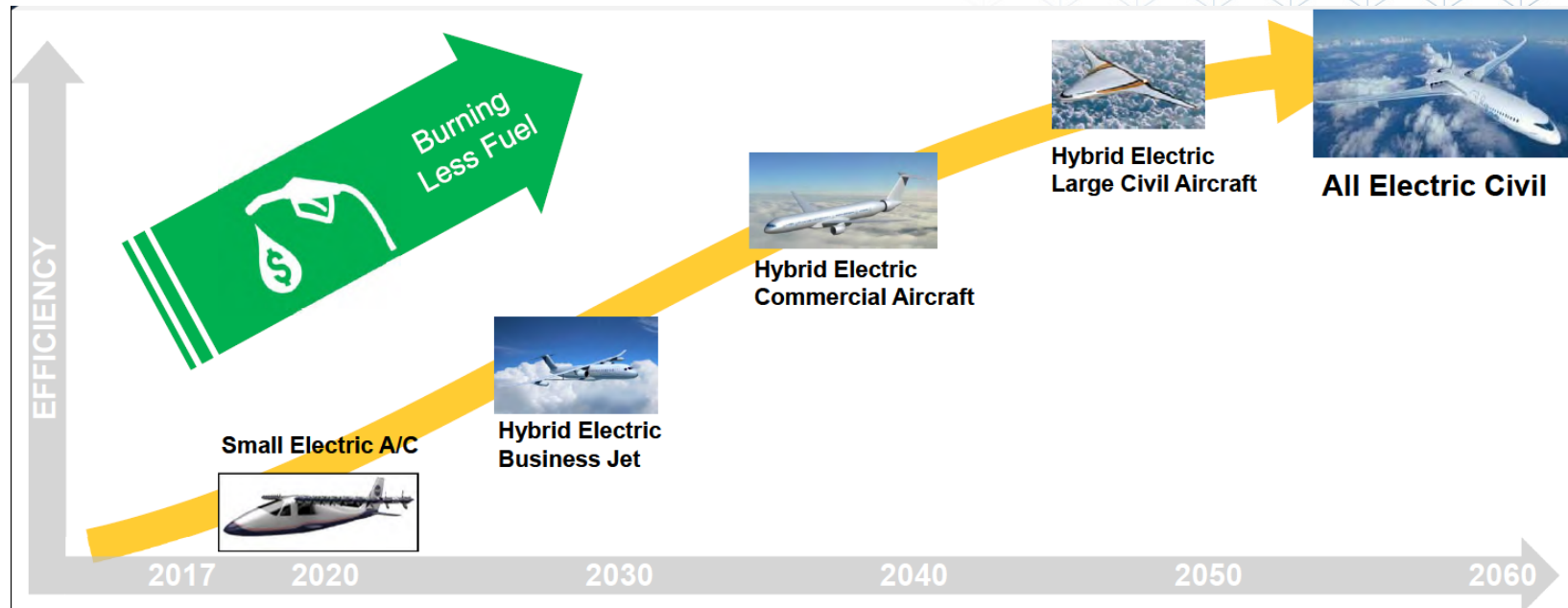
Electrification and hybrid propulsion

Long haul with large aircrafts

Bio-fuel

Liquid hydrogen

Electrification and hybrid



The way forward

Lightweight technology

New aircraft technology will change the traveling the pattern

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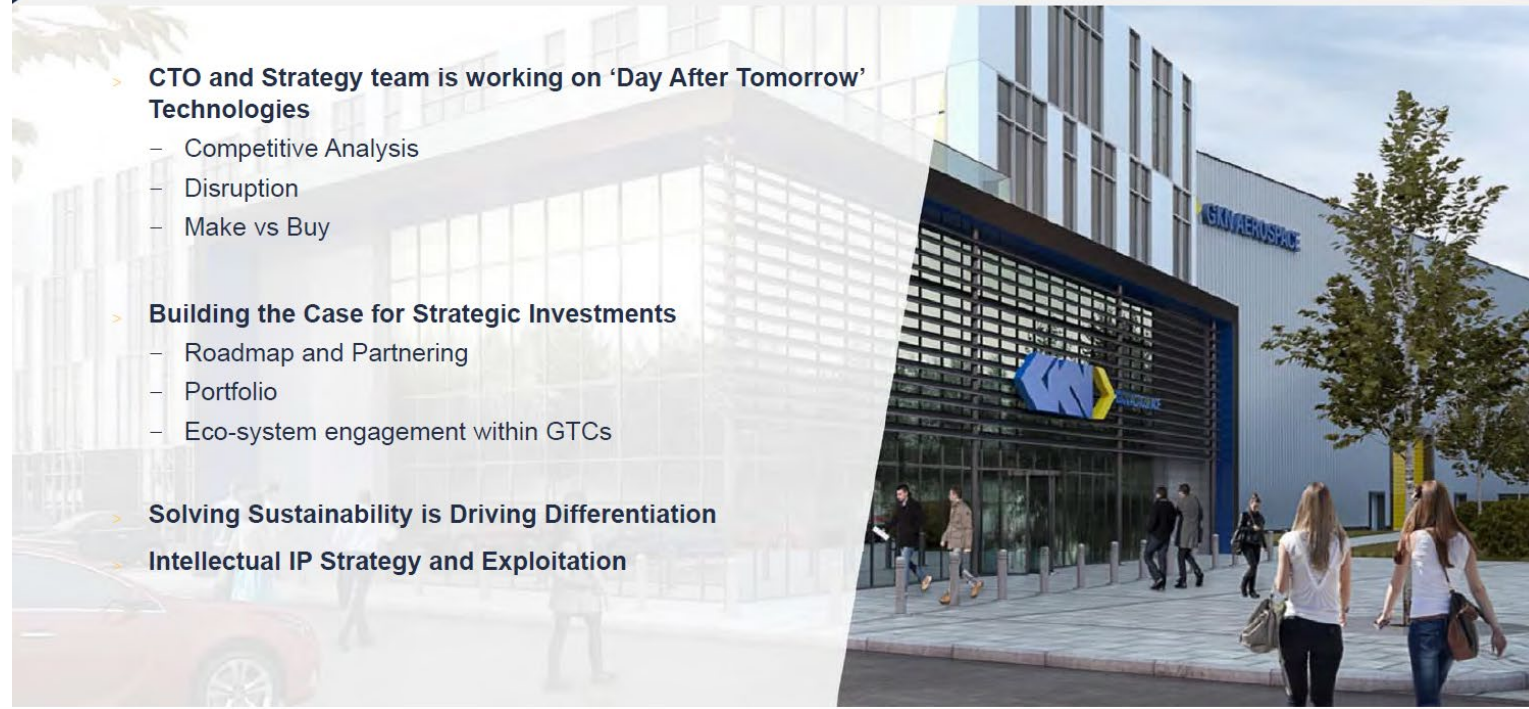
Increase efficiency in the whole supply chain

Industry 4.0

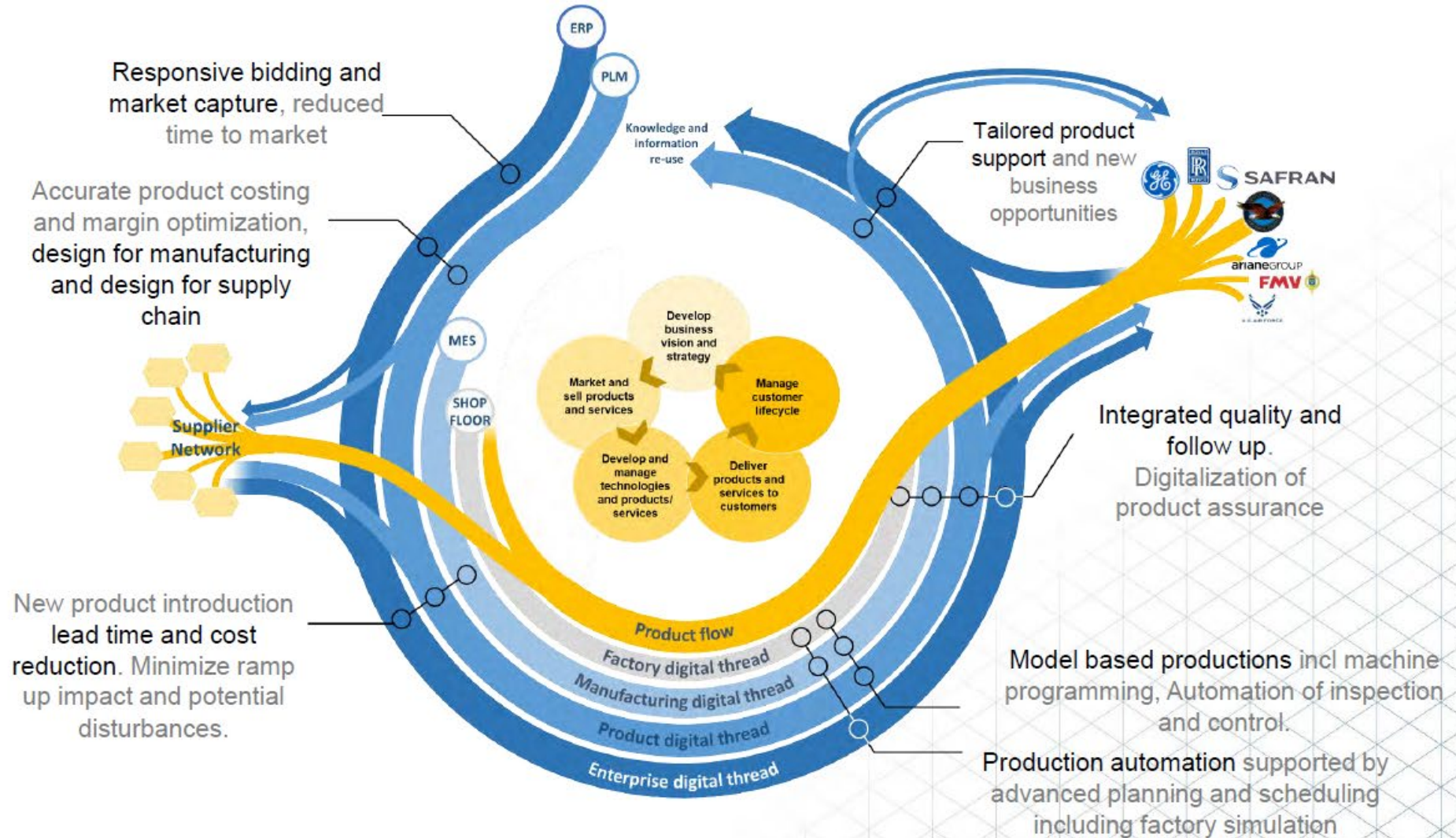


Technology ecosystems: 'Day After Tomorrow' Technologies & Strategic Initiatives

- > **CTO and Strategy team is working on 'Day After Tomorrow' Technologies**
 - Competitive Analysis
 - Disruption
 - Make vs Buy
- > **Building the Case for Strategic Investments**
 - Roadmap and Partnering
 - Portfolio
 - Eco-system engagement within GTCs
- > **Solving Sustainability is Driving Differentiation**
- > **Intellectual IP Strategy and Exploitation**



The Industry 4.0 potential





GKN Aerospace Global Technical Centres



The way forward



DATA



KNOWLEDGE



ACTION





Kongsberg Technology Park

World class high-tech mechanical solutions. Expansions both domestic and global.

In numbers

- > 5300 employees
- > Sales \$ ~5 Bill (NOK ~45 Bill)
- > 40 companies



KONGSBERG



NCE and local knowledge providers

Kongsberg the city with highest density of engineers in relation to no of inhabitants

Norwegian Center of Expertise in Systems Engineering

Eco system of companies and technology providers in Kongsberg

High school

Apprenticeship

Vocational college

University



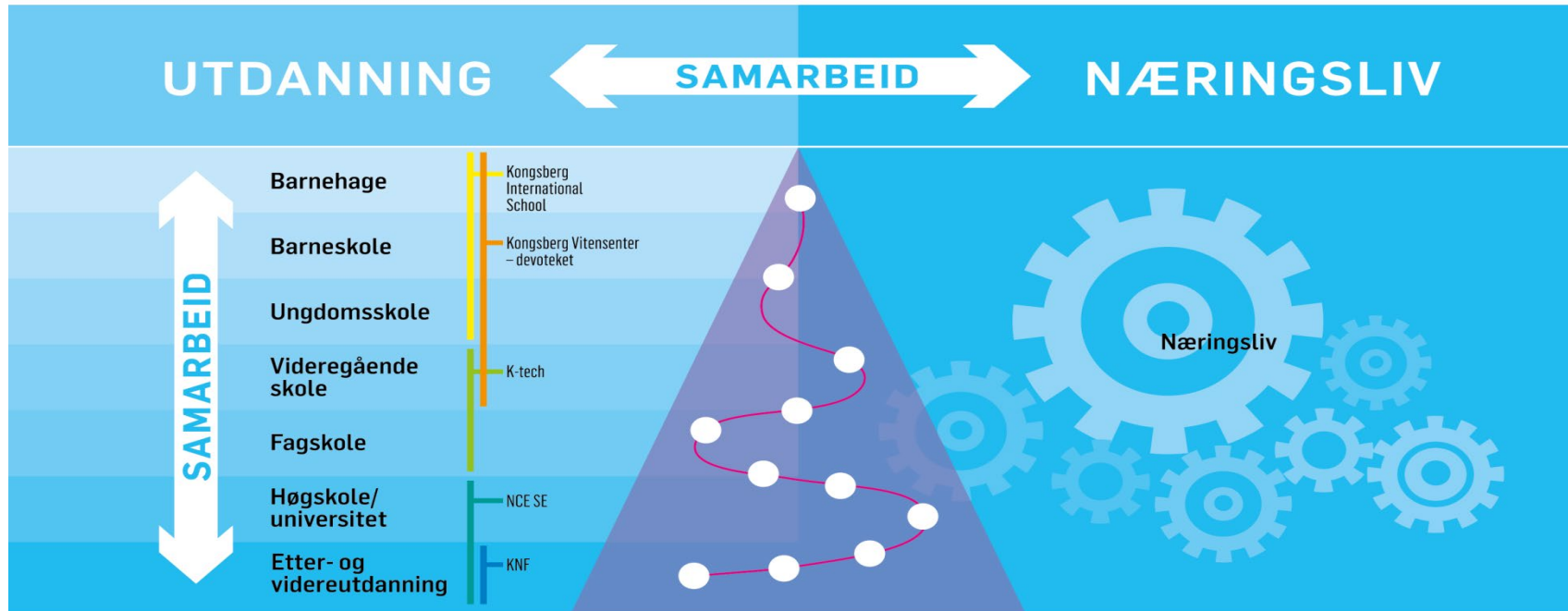
The screenshot shows the website for Norwegian Centres of Expertise (NCE) Systems Engineering Kongsberg. The header includes the NCE logo and navigation links: Forside, Om NCE, Nyheter, Nye bedrifter, Kunnskapsutvikling, Leverandørutvikling, Kontakt oss, and English. A search bar is located in the top right corner.

The main content area is divided into several sections:

- Systems Engineering:** A section describing Systems Engineering as a recognized method for system development, with links for more information and master studies.
- Partnerbedrifter:** A grid of logos for partner companies including FMC Technologies, ARGOS SOLUTIONS, ESKO artwork, KONGSBERG, GKN AEROSPACE, KONGSBERG AUTOMOTIVE, devotek, and DRESSER-RAND.
- Nyheter (News):** A section with three news items:
 - Masterstudenter jobber med business-case i Kina:** A report on a business case competition in Shanghai.
 - Suksess for Åpen dag:** A report on an open day at Kongsberg Technology Park and the Arsenal.
 - Fra outsourcing til homesourcing:** A report on the company's 20th anniversary and future plans.
- Kurs (Courses):** A section listing courses such as 'Systems Engineering våren 2015' and 'Planlagte kurs hos K-tech høsten 2014'.
- Søknadsfrister (Application Deadlines):** A section listing deadlines for 'SkatteFUNN', 'MAROFF', 'Europaisk forskningsarena', and 'Forprosjekter'.
- Partnerbedriftene (Partner Companies):** A list of partner companies including Argos Solutions AS, Dresser-Rand AS, Esko-Graphics Kongsberg AS, FMC Technologies AS, GKN Aerospace Norge AS, Kongsberg Automotive ASA, Kongsberg Devotek AS, and Kongsberg Gruppen ASA.

At the bottom, there is a Facebook widget for NCE Systems Engineering, Kongsberg, and a 'Nyhetsbrev' (Newsletter) sign-up button.

Technology pyramid



Teknologipyramiden



KONGSBERG



FESTO Industri 4.0 laboratorium Cyber Physical Factory



System set up as a flexible production system using mobile phones as demo product. The cell consists of:

- Robot
- Collaborative robot
- Integrated CNC machining
- Additive manufacturing (3D printing)
- Intelligent warehouses
- AGV/mobile robots
- Vision based QA inspection
- ERP/MES system
- Data security
- PLC (Siemens/Codesys)
- Micro controller/Raspberry PI
- AR (augmented reality)



Investment 10,4 MNOK (~1 MEUR)

Thank you for your attention!



Ole B. Hoen | Vice President CoE and R&T | GKN Aerospace Engine Systems Norway

Kirkegårdsveien 45 N-3601 Kongsberg | Norway

Mobile: +47 924 12 797

ole.hoen@gknaerospace.com | www.gknaerospace.com