

Sustainable aviation

Business threat or business opportunity?

“Look, think and act differently”

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Lucht- en Ruimtevaart Nederland

NAG Segmentenbijeenkomst 27-9-2019



Lucht- en Ruimtevaart Nederland



LOOK DIFFERENT

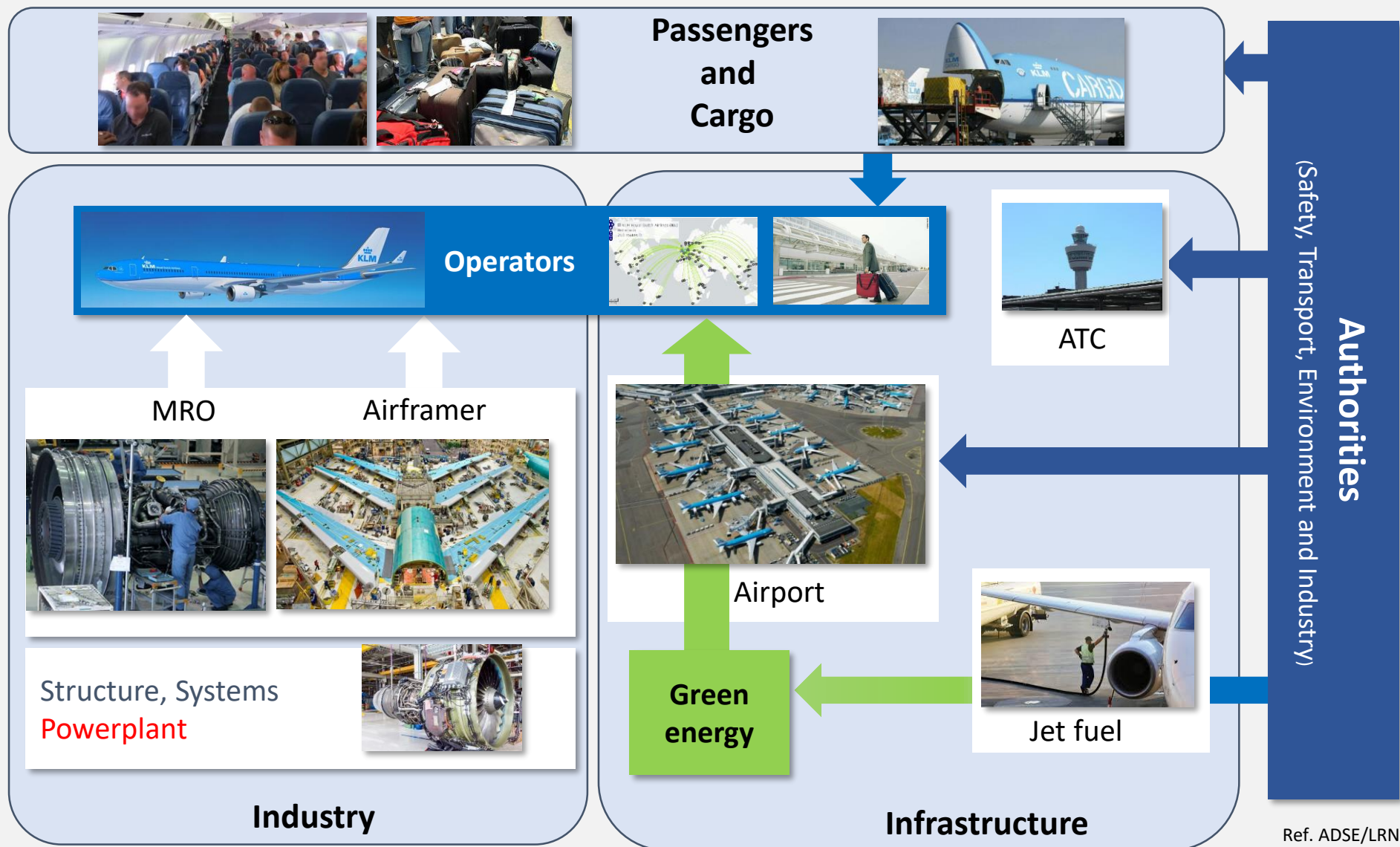


IATA: 4 billion travelers in 2018

Forecast Predicts 8.2 billion Air Travelers in 2037

A photograph of a KLM Royal Dutch Airlines aircraft, a white and blue wide-body jet, parked on an airport tarmac. The aircraft is positioned in the foreground, angled towards the right. In the background, airport infrastructure is visible, including a control tower, terminal buildings, and other aircraft. The sky is blue with scattered white clouds. The text "IATA: 4 billion travelers in 2018" and "Forecast Predicts 8.2 billion Air Travelers in 2037" is overlaid on the top left of the image.

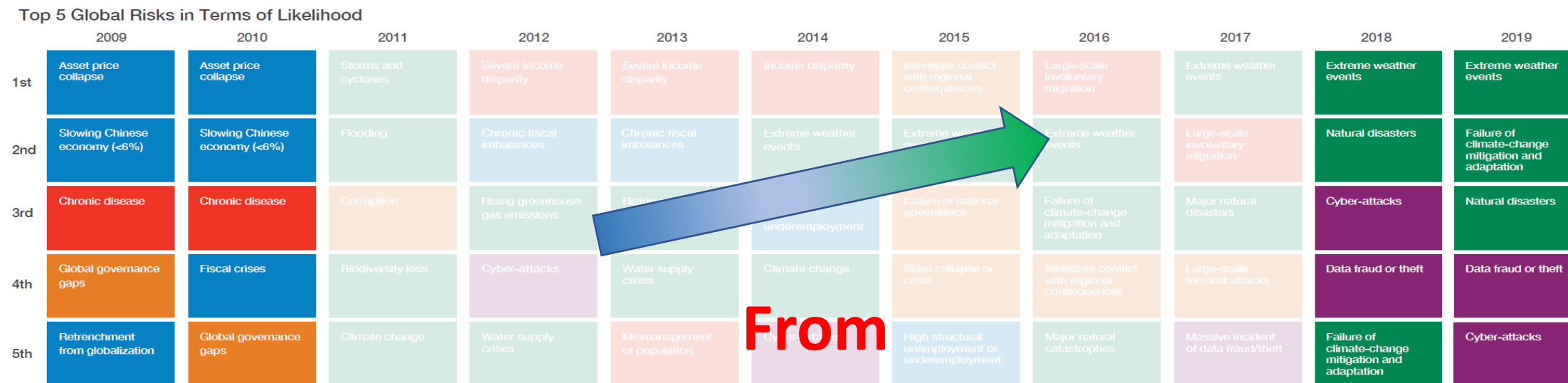
Value chain air transport – aviation ecosystem



Ref. ADSE/LRN



Figure IV: The Evolving Risks Landscape, 2009 – 2019



From
economic risk



to
environmental risk

■ Economic ■ Environmental ■ Geopolitical ■ Societal ■ Technological

Source: World Economic Forum 2009–2019, Global Risks Reports.

Note: Global risks may not be strictly comparable across years, as definitions and the set of global risks have evolved with new issues emerging on the 10-year horizon. For example, cyberattacks, income disparity and unemployment entered the set of global risks in 2012. Some global risks were reclassified: water crises and rising income disparity were re-categorized first as societal risks and then as a trend in the 2015 and 2016 *Global Risks Reports*, respectively.

THINK DIFFERENT while looking at the trends



Demographic

2019 : 7.7 billion

2037: 9.0 billion

2050: 9.7 billion

2070: 10.5 billion



Economic

Sustainable

Growth

**Growing middle
class**



Political

Brexit

Trade wars

**Fragmented
World**

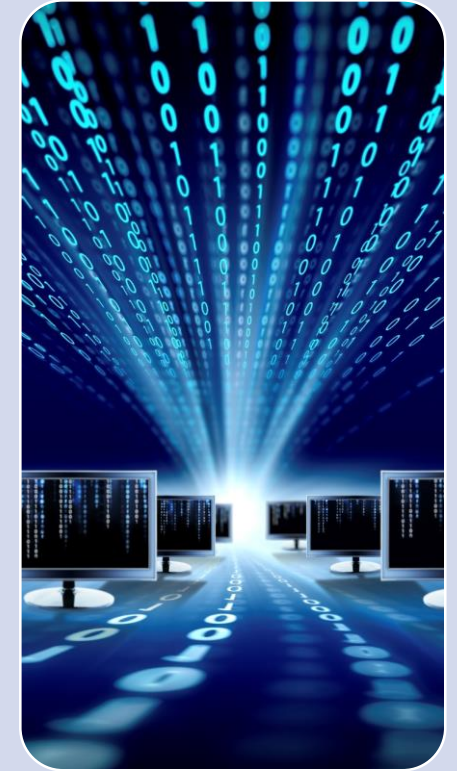
Multipolar



Ecological

Energy

Emissions



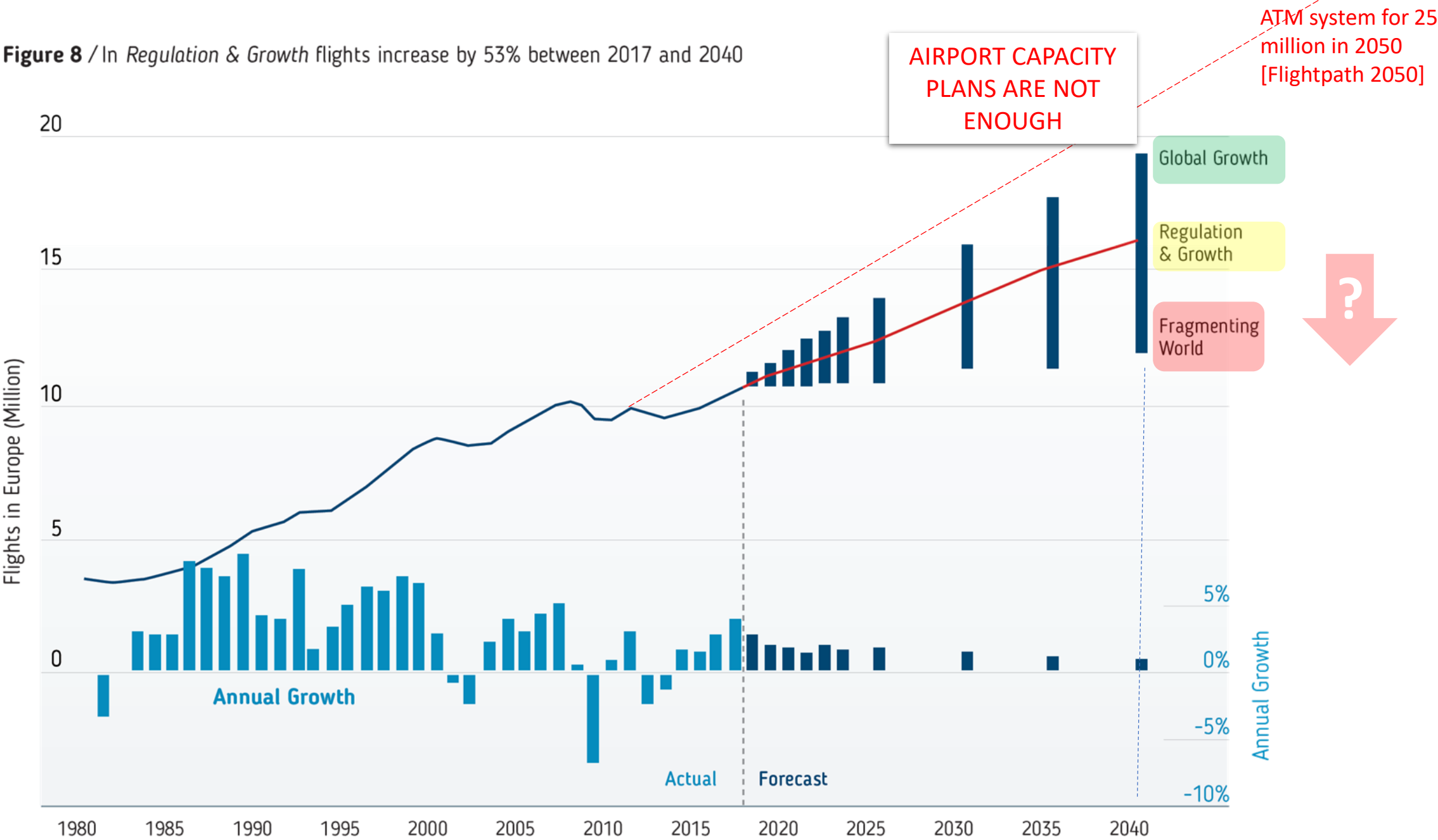
Technology

Electrification

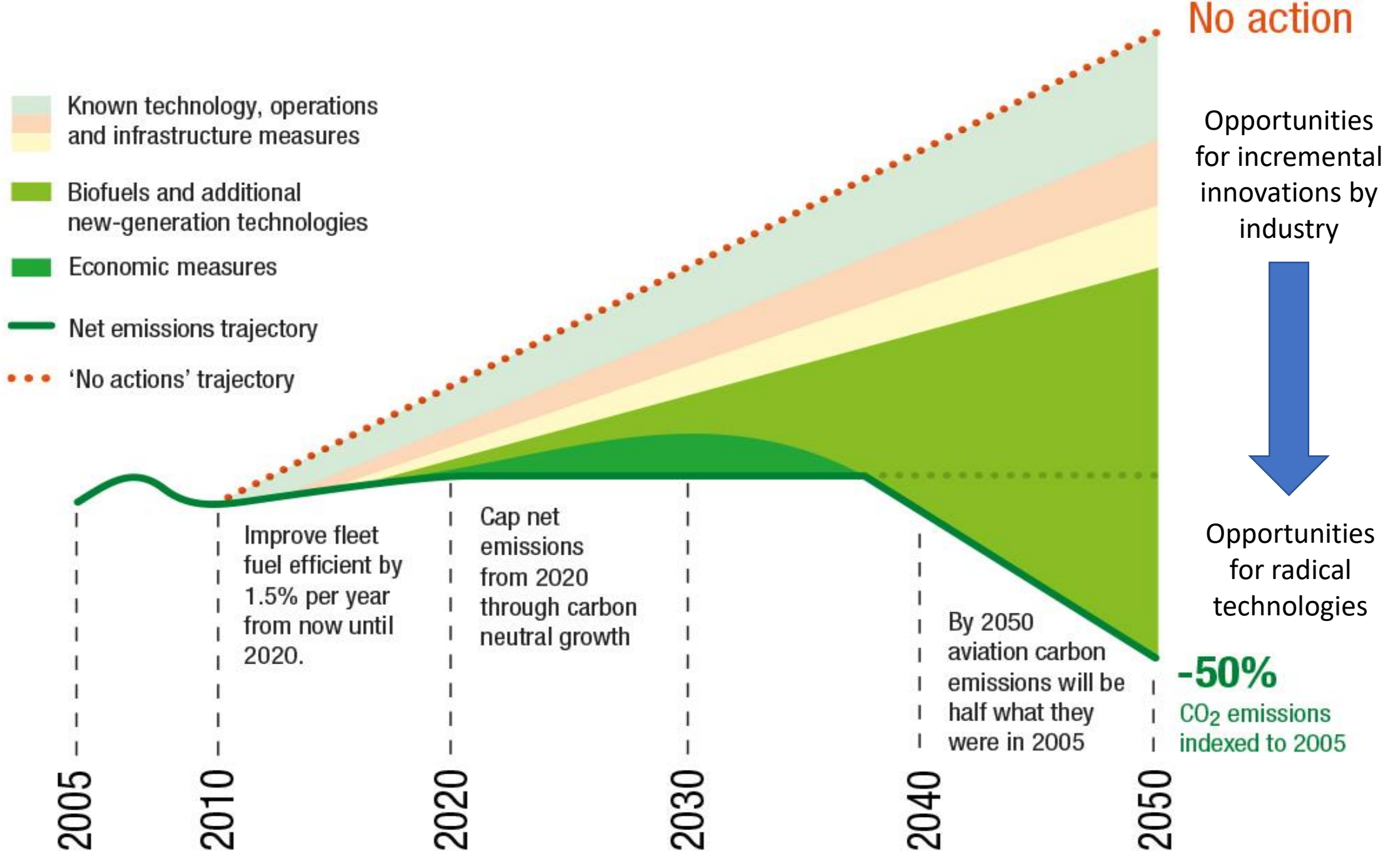
Drones

Biometrics

Figure 8 / In Regulation & Growth flights increase by 53% between 2017 and 2040

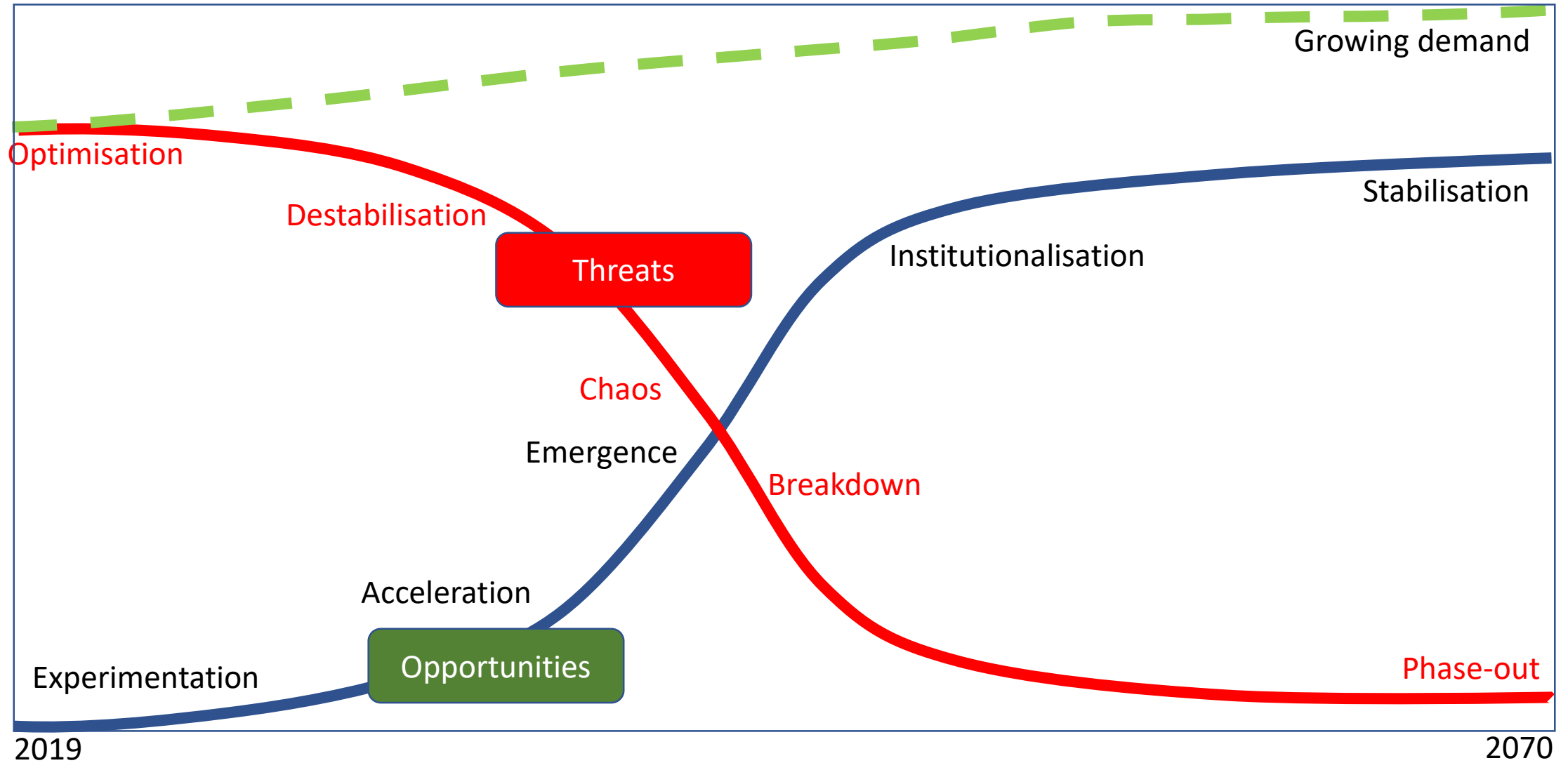


[Source: EUROPEAN AVIATION IN 2040, CHALLENGES OF GROWTH, Eurocontrol, 2018]



ACT DIFFERENT

Transition into a sustainable aviation ecosystem



Netherlands among the frontrunners in 2030



Ontwerpakkoord
Duurzame
Luchtvaart

Versie 2019 - 02 - 21



Slim én duurzaam

Meer kansen en 30% minder CO2 in 2030 voor de Nederlandse luchtvaart

In hybrid electric aviation

Action Programme Preparation 2019 Phase Commercial Aviation



Government of the Netherlands



AIRLINES

Lucht- en Ruimtevaart Nederland

Resultaten SWOT – Reductie CO2 door Elektrisch Hybride Vliegen

STRENGTHS <ul style="list-style-type: none"> Cryogenics (-) Kennis en kunde van waterstofdrukkaten. (Pronexos) Meer dan 100 jaar ervaring in luchtvaartindustrie (NAC) State of the art, software for design and engineering for E & H flying. (Siemens) 	WEAKNESSES <ul style="list-style-type: none"> Gebrek aan OEMs en integrators. (ADSE) Geen motorfabrikanten. Geen volledig vliegtuig wordt in Nederland gebouwd. (NLR) Ieder voor zich te klein (NAC) IP en design capabilities zitten niet dicht genoeg bij designers van nieuwe motoren (OEMs). Elektrisch/Hybrid. (Bosman) NL heeft geen eigen vliegtuigbouwer, dus afhankelijk van grote OEMs. (KLM)
OPPORTUNITIES <ul style="list-style-type: none"> Demonstrators, city airbus. E-fan-x, extra 33 LE (Siemens) Drastically shorten time to market (Siemens) Foreign government roadmaps (ADSE) Inclusion GKN engine system and GKN automotive (Fokker) Nederland is uiterm land om korte afstand elektrisch vliegen pilot te starten. Paalen airlines en OEMs (Bosman) Nieuwe markt biedt exportmogelijkheden (NLR) Praat met Lightyear Helmond, auto op basis van zonnecellen. (Egmond) Toename in maatschappelijk draagvlak voor verduurzaming van de luchtvaart (NLR) Urgentie van klimaatverandering neemt toe (NLR) Veel nieuwe kleinere OEMs, drones, urban mobility > doorgroen naar regional aircraft? (NLR) 	THREATS <ul style="list-style-type: none"> Infrastructure (airport, fuel, subsidy) not in place (-) Lange ontwikkeltijd, lange terugverdiendtijd (NLR) Publieke opinie tegen luchtvaart, we gaan te langzaam (DGTA) Regelgeving, internationaal ontwikkeling van fuel cell. (Pronexos) Stronge regelgeving (NLR)

31-1-2019

NAG/LRN Segmentbijeenkomst Aircraft Manufacturing

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Lucht- en Ruimtevaart Nederland

Roadmap 2025-2040

TRL	2025	2030	2040
Markt		<ul style="list-style-type: none"> CFRP drukvaten voor waterstof opslag (350-700 bar) (Pronexos) "Deelname in projecten TUD: Vb. "AHEAD" (KLM E&M)" We werken veel intensiever met elkaar samen (DGTA) 	<ul style="list-style-type: none"> Nederland voert pro-actieve discussie met engine OEMs (KLM E&M) Systeemontwerper en leverancier voor waterstofsysteinen in vliegtuigen (Pronexos) We zijn op elkaar ingewerkt en doen internationaal mee als specialist. (DGTA)
Product TRL 7-9		<ul style="list-style-type: none"> 100% biofuel na certificatie wijzigingen (nu 50-50 blend) (KLM E&M) Elektrificatie van subsystemen + Cabin pressurization, cabin cooling, OBOGGs, OBOGGs and small drone motors (<100 kW) (Aeronamic) Waterstofdrukat (350-700 bar) gecertificeerd voor in-flight toepassingen, (Pronexos) 	<ul style="list-style-type: none"> Elektrificatie van subsystem: all drone motors (Aeronamic)
Technology TRL 4-6	<ul style="list-style-type: none"> Ontwikkelen en fabriceren van hittebestendige composiet onderdelen. Ceramic Matrix Composites (CMC) (Bosman) 	<ul style="list-style-type: none"> Cryogeen CFRP drukvat voor waterstof. (Pronexos) Door samenwerking is de technologie bekend en toegepast (DGTA) "Ontwikkelen "dubbel flow ducts / tubing" heat exchangers (Bosman)" Propulsion plus cryosystem and large drone motors (> 100 kW) (Aeronamic) 	<ul style="list-style-type: none"> Effecten van nieuwe technologie worden zichtbaar (DGTA)
R&D TRL 1-3	<ul style="list-style-type: none"> R&D ontwikkeling in cryogene technologie (Pronexos) Ontwikkelen van CO2 reductie tijdens onderhoud: testen / proefdraaien (KLM E&M) 		

21-5-2019

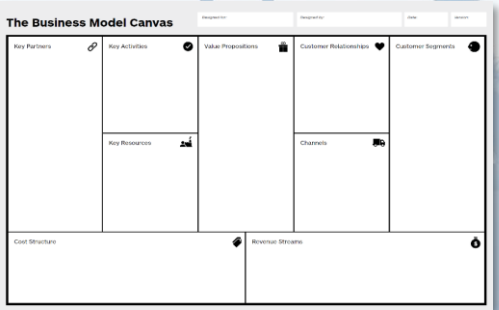
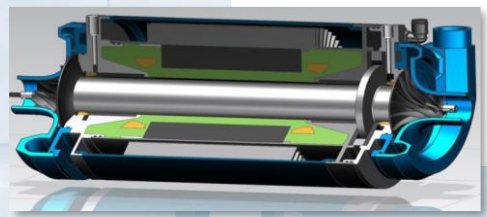
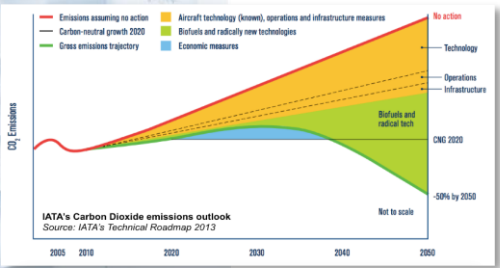
DGTA Workshop Hybride Elektrisch Vliegen - Aeronamic, Almelo



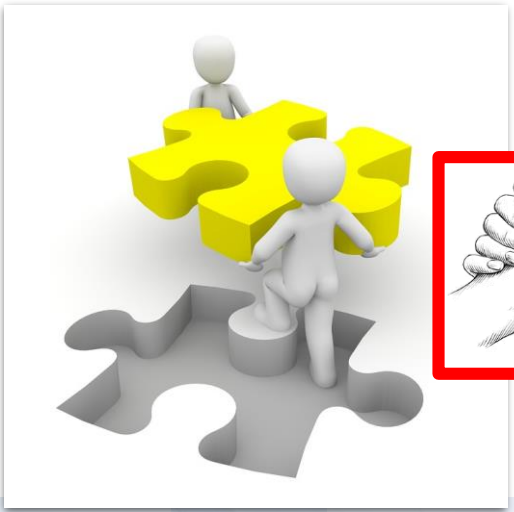
Smart mobility. Dutch reality.



Dedicated to innovation in aerospace



Strengths



Weaknesses



Opportunities



Threats



Embrace change: LOOK, THINK & ACT DIFFERENTLY

NOW

- Opportunity for transition aviation ecosystem
- Time to rethink ways for cooperation
- Outline AHEV Programme under construction

WHAT

- Zero fossil fuel emissions
- Radical new (propulsion) technologies
 - Electrification
 - Hybridisation
 - Hydrogen
- Impact on MRO
- Impact business models

HOW

- In national and international **cooperation**, with research, industry, government, OEMS and airlines
- ...in a fragmenting World
- significant investments



Lucht- en Ruimtevaart Nederland



Advancing your
Aerospace and Airport Business

Smart mobility. Dutch reality.