



The Swedish Strategic Innovation Programme for Aeronautics

Sweden Innovation Days, Dubai, 220119

www.innovair.org

With support from:



STRATEGISKA
INNOVATIONS-
PROGRAM

Aeronautics in Sweden

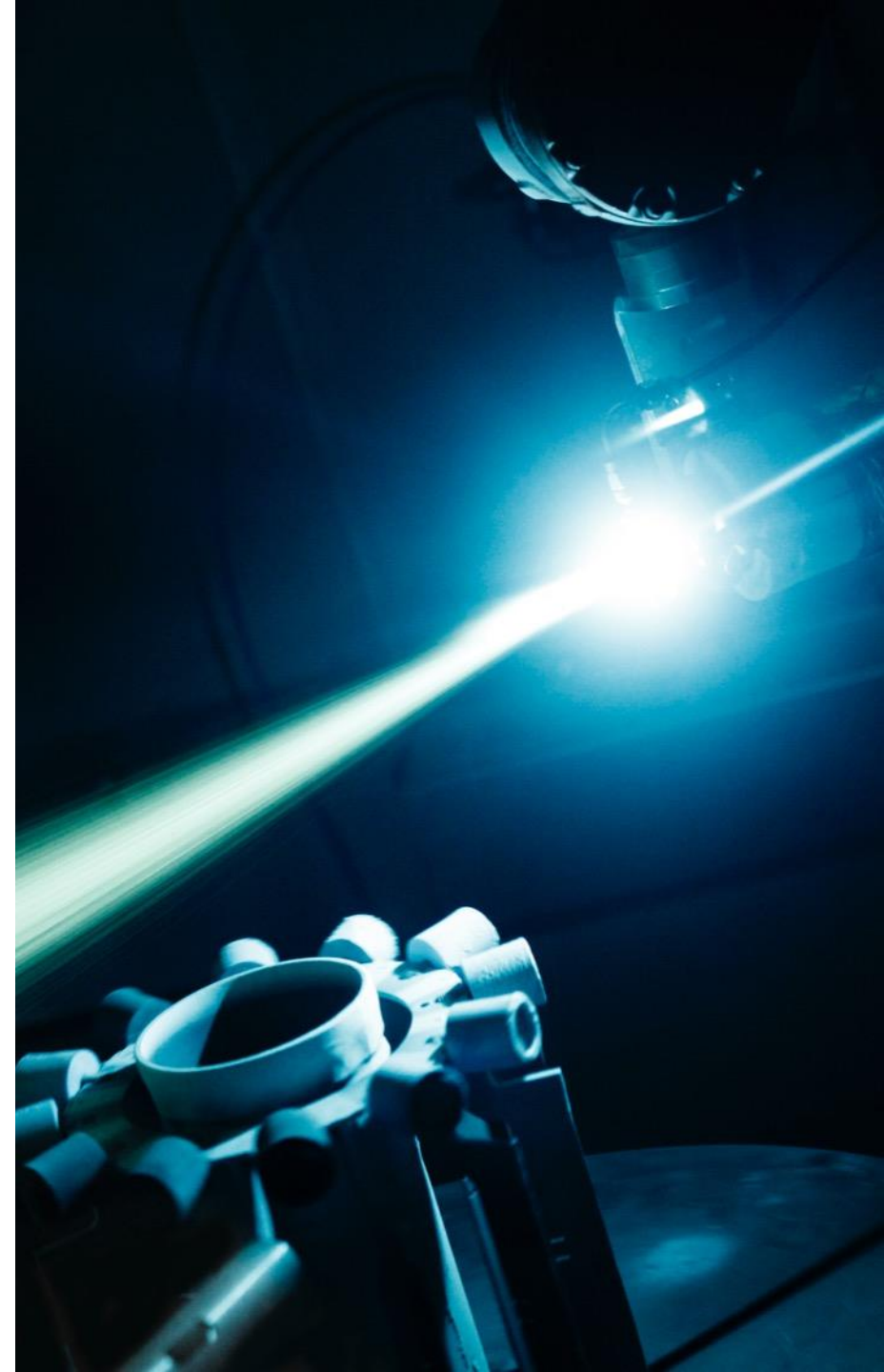
- Long aeronautical history ...
- ... with well structured actors in academia, institutes, SMEs, and large industries
- ... coordination between civil and military aeronautics providing a military capability ...
- ... which is unique for such a small country



Swedish Aeronautical Innovation

Industry in general:

- Over 12,000 employees
- A turnover of more than 2.2 billion Euro per year
 - Objective 2050: 4 billion Euro per year
- SME turnover of more than 50 million Euro per year
 - Objective 2050: 250 million Euro per year
- An export share of some 70 %
 - Objective 2050: 90 %
- Swedish components in more than 90% of all new civil aircraft/engines



Swedish Aeronautical Innovation

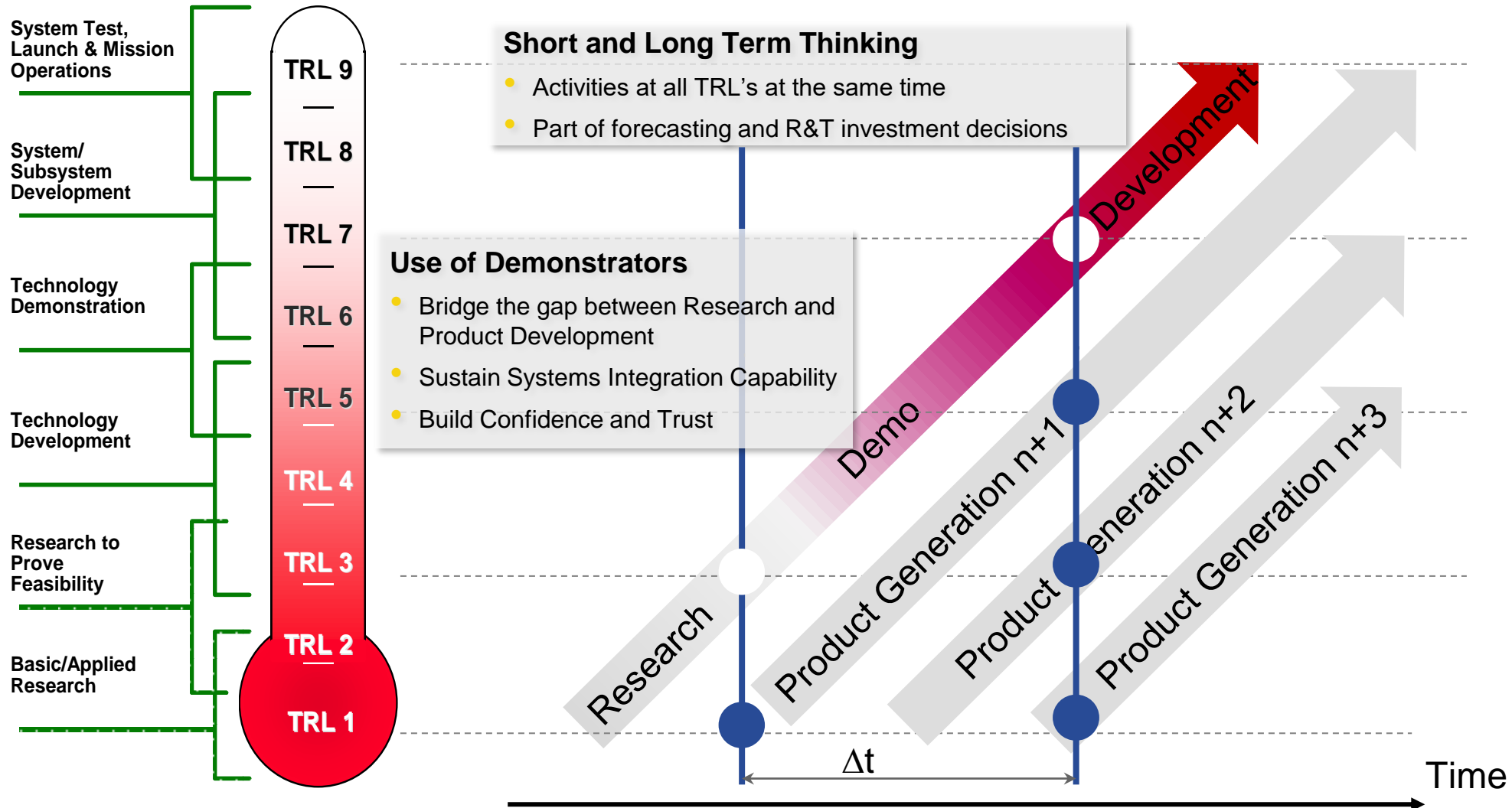
Innovation coordination: Innovair

- One of the first six strategic innovation programmes (funded by Ministry of Enterprise and Innovation and Ministry of Defence)
- Both civil and military applications
- Coordinates and supports all stakeholders:
 - Low–mid–high TRL (academy–institutes–industry)
 - Public sector (end users, governmental agencies)
 - Financial programmes
- Strategy for Swedish aeronautical innovation: NRIA Flyg (2010–2013–2016–2020)
- SARC – Swedish Aerospace Research Centre
 - KTH (Stockholm)
 - LiU (Linköping)
 - Chalmers (Gothenburg)
 - LTU (Luleå)
- Aerospace Cluster Sweden (SME focus)



THE SWEDISH STRATEGIC INNOVATION
PROGRAMME FOR AERONAUTICS

TECHNOLOGY MATURATION



Strategic innovation agendas

- Direct Innovair activities and are **produced by the joint actors in collaboration.**
- Produced every three to four years since 2010.
- Define **long term strategic targets** which are fairly stable over time
- ... och **short term goals** that are continuously updated.
- These cover **civil and military** aspects, from **regional to national, bilateral, and multinational levels**



Swedish Aeronautical Innovation

Internationalisation

- Multinational:
 - EU (Clean Sky, SESAR)
 - EDA (MIDCAS)
 - European Defence Fund
 - nEUROn
 - ACARE (EREA, ASD, EASN, ...)
 - GARTEUR
 - IFAR
- Bilateral:
 - Brazil
 - UK
 - Germany



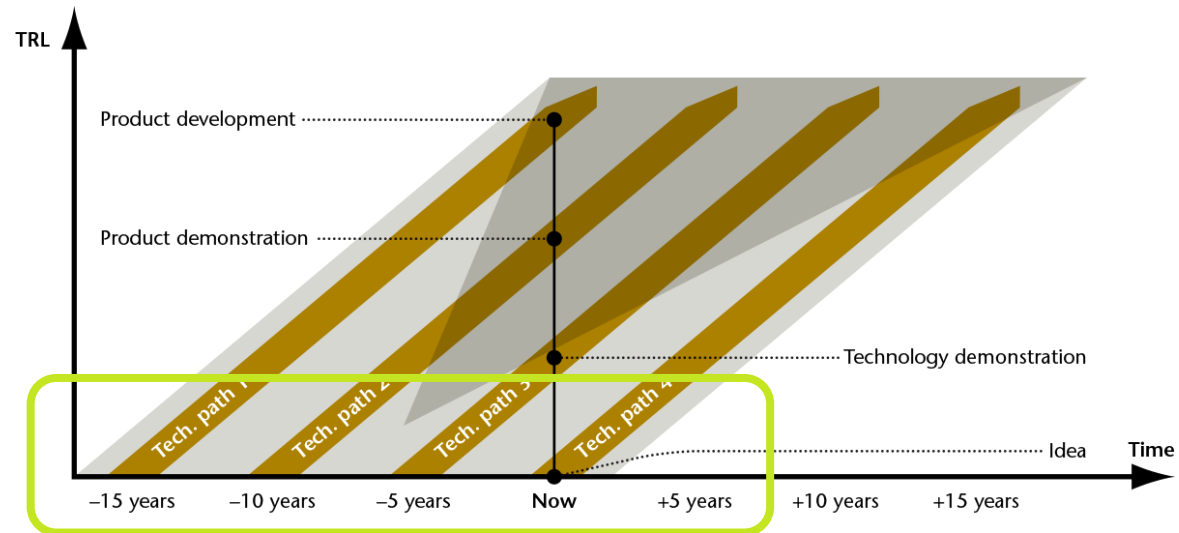
Swedish Aerospace Research Center – a National Research Network

SARC is a national aeronautical research centre hosted by Swedish Universities and funded by Innovair, one of the first Vinnova strategic innovation programmes.



Background

- Increased international competition requires a more articulate process to ensure Sweden's competitiveness.
- A smooth running innovation system, from early research, through demonstrators to products.
- There is an increased need for research at low technology readiness levels (TRL) at universities.

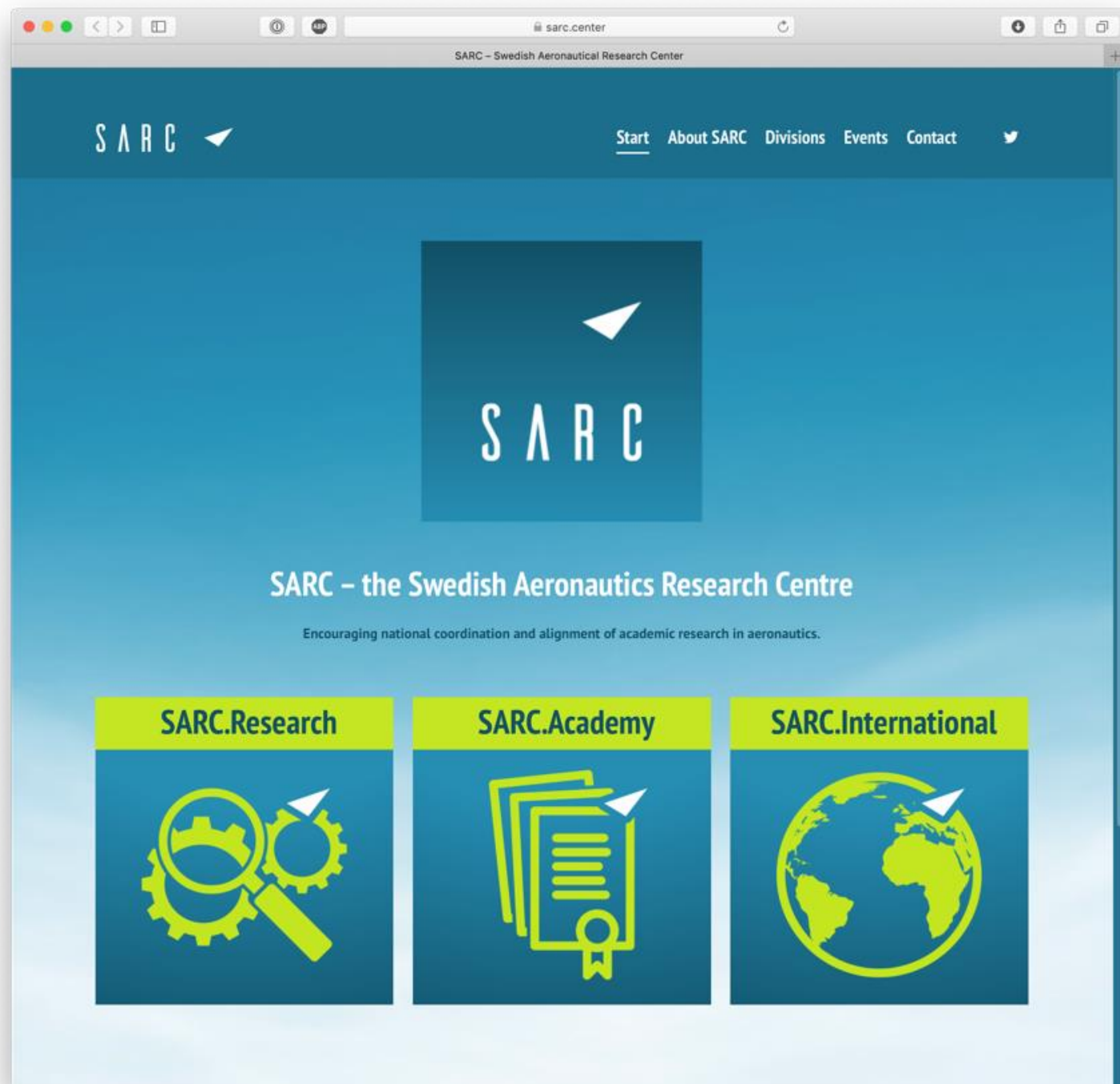


The vision of SARC

To be the leading Network of Aerospace researchers in Sweden, fostering collaboration among researchers and graduate students, influencing aerospace policy and facilitate funding for fundamental aerospace research.



sarc.center



SARC Collaborative project

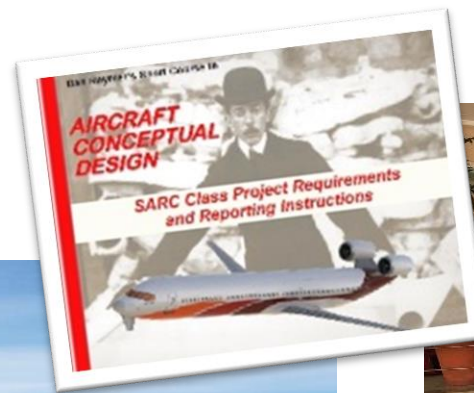
What is the collaborative project?

- **Common platform** for applied aviation courses and research
- Evaluate impact of **new technologies** (hydrogen, NLF...)
- **Green** regional air transport in focus
- **Pilot project** for collaborative research



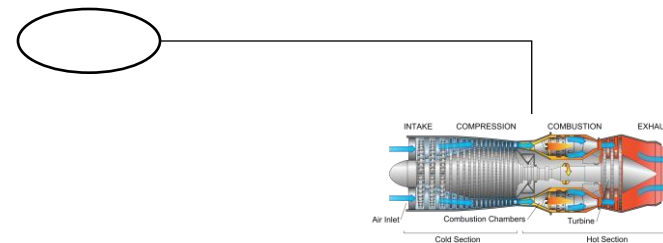
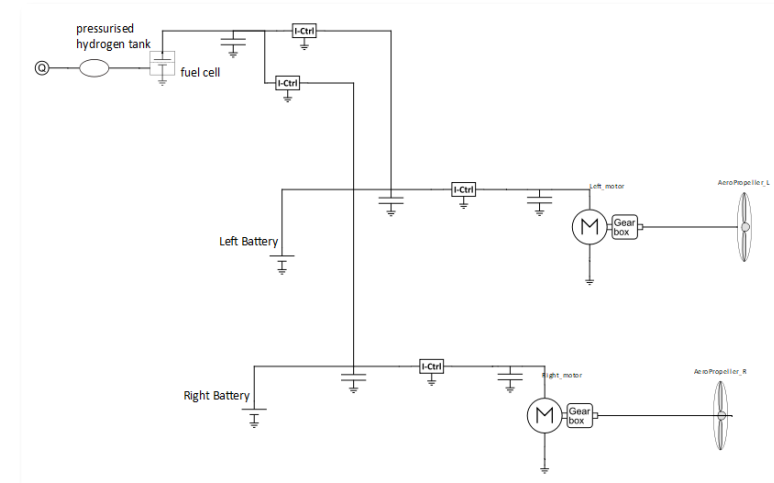
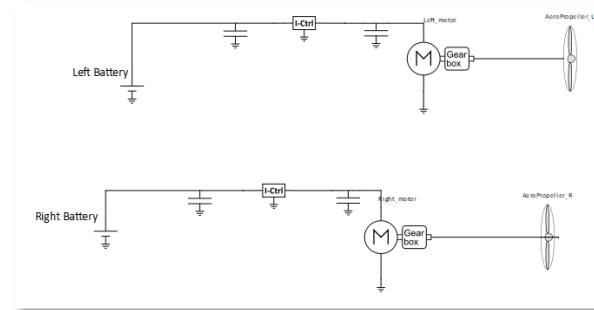
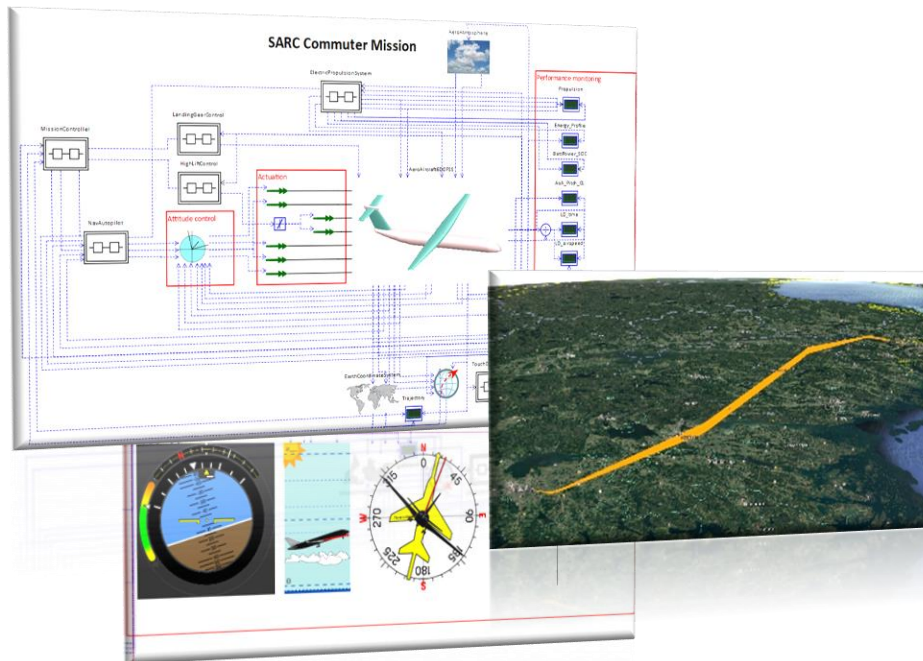
Conceptual aircraft design

- Conceptual design initiated at D. Raymer's course in Brazil
- Basic assumptions to fit tank and TRL (40 pax, regional range...)



Concepts

- Battery Electric Aircraft
- Fuel cell Electric Aircraft
 - High pressure tanks
 - Cryogenic tanks
- Hydrogen burning in gas turbine





1st SARC-BARINET

AEROSPACE COMPETITION

COLLABORATIVE UNMANNED
AERIAL VEHICLES



SAAB



AEROSPACE
CLUSTER
SWEDEN



2022-01-19

16



USP



UFMG

Recent On-line event Nov 18-19 2021



BARINet



SARC

SARC-BARINET Aerospace Workshop, SBAW2021

		Person/Chairman	Affiliation	Topic	email
BR	SE	Day 1, Nov 18			
8:30	12:30	Welcome and Introduction			
8:30	12:30	Alessandra Holmo	CISB	Welcome	alessandra.holmo@cisb.org.br
8:35	12:35	Petter Krus	LIU	Welcome	petter.krus@liu.se
8:40	12:40	Emilia Villani	ITA	Welcome	evillani@ita.br
BR	SE	Session A- Low Emission			
8:45	12:45	Fernando Catalano (ITA) and Tomas Grönstedt (Chalmers)			
9:00	13:00	José Faundez Alarcon	KTH	Active control of boundary-layer instabilities	josfa@kth.se
9:05	13:05	Diego Audiffred	ITA		
9:10	13:10	Stefan Wallin	KTH	Dynamics of the deployment of a Krüger high-lift device by numerical simulations within the UHURA H2020 project.	stefanw@mech.kth.se
9:15	13:15	Pedro Bravo Mosqueira	USP	Low fuel burn configuration	
9:20	13:20	Fabiola Costa	Chalmers	Propeller performance and noise prediction	
9:25	13:25	Round table discussion			
9:35	13:35	Daniel Rosell	Chalmers	Military engine performance modelling and	
9:40	13:40	Marcos Vinicius	USP	Distributed electrical propulsion	
9:45	13:45	Oliver Sjögren	Chalmers	Conceptual modelling and design of future	
9:50	13:50	Round table discussion			
10:00	14:20	Break			
		Session B - Aeroacoustics			
10:10	14:10	Susann Boij (KTH) & André Cavalieri (ITA)			
10:15	14:15	Gonzalo Montero Villar	CTH	Aeroacoustics modelling for propulsion	
10:25	14:25	Alex Sano	ITA		
10:20	14:20	Mihai Mihaescu	KTH	LES of Supersonic Jets at High Temperatures: Flow and Aeroacoustic attributes	mihai@mech.kth.se
10:25	14:25	Gabriel Gouveia	USP	Slat noise control	
10:30	14:30	Marilyn Thoma	CTH	Noise and emissions interdependency modelling	
10:35	14:35	Round table discussion			
BR	SE				
10:45	14:45	Break			
BR	SE	Session C - Aerospace Systems			
		Victor de Negri, Petter Krus			
		victor.de.negri@ufsc.br, petter.krus@liu.se			
10:55	14:55	Magnus Eek	Saab	System modelling and simulation at Saab	
11:10	15:10	Dimitri Oliveira e Silva	UFSC	Electro hydrostatic actuator	dimitri.oliveira@unifesspa.edu.br
11:15	15:15	Christopher Reichenwallner	LIU	Design perspectives for aircraft actuation systems	christopher.reichwalner@liu.se
11:20	15:20	Artur Tozzi C. Gama	UFSC	Multi-mode actuators	arturcantuaria@gmail.com
11:25	15:25	Ludvig Knöös Franzén	LIU	Ontologies for system of systems	ludvig.knoos.franzen@liu.se
11:30	15:30	Round table discussion			
11:40	15:40	Presentation of SARC-BARINET competition			

Day 2, Nov 19

BR	SE	Session D - Systems Engineering and SoS	Emilia Villani, Ingo Staack	
8:30	12:30	Christopher Jouannet	Saab	SoS at Saab
8:40	12:40	Josge Lovaco	LIU	Fire fighter system modelling
8:45	12:45	Vitor Sant'Ana	UFF	Neuro fuzzy modelling of aerodynamics
8:50	12:50	Robert Hallqvist	LIU/Saab	Digital twin
8:55	12:55	Round table discussion		
9:05	13:05	Jens Alfredson	Saab	HMI at Saab
9:15	13:15	Karl Kindström Andersson	Saab/UFSC	Design for system of systems
9:20	13:20	USP		
9:25	13:25	Alexandra Oprea	LIU/Saab	
9:30	13:30	Round table discussion		
		Session E - UAV, Autonomous Systems and AI		
		(Roberto Gil da Silva, Fredrik Heinz)		
9:40	13:40	Fredrik Heinz	LIU	
9:55	13:55	Andrew Sarmiento	ITA	Sensor fusion applied to GNS of autonomous systems
10:00	14:00	Siwat Suewatanakul	KTH	Hybrid/Electric Unmanned Aerial Vehicles Development at KTH Aeronautics - An Overview
10:05	14:05	Danilo Sartori Alarcon	USP	A Reinforcement Learning Approach for eVTOL
10:10	14:10			
10:15	14:15	Round table discussion		
		Session F - Aerospace Structures, Manufacturing and Materials		
		Ola Isaksson, Mariano Arbelo		
10:30	14:30	Dan Zenkert	KTH	Shape Morphing Carbon Fibre Composites
10:45	14:45	Viktor Sandell	LTU	Defect based fatigue life prediction of additive manufactured titanium alloy
10:50	14:50	Dante Krivtsov De Grandis	ITA	
10:55	14:55	Olivia Borgue	Chalmers, Luxemburg	Qualification methodology for additive manufacturing space application (aerospace)
11:00	15:00	Felipe Ruivo Fuga	ITA	
11:05	15:05	Vivek Pakkam Gabriel	LTU	Intralaminar cracking in GF/EP laminate composites
11:10	15:10	Round table discussion		
		Session G - Space		
		Anna Öhrwall		
11:25	15:25	René Laufer	LTU	
11:40	15:40	Lidia		
11:45	15:45	Bernd Weiss	LTU	Re-use of space debris (business)
11:50	15:50	Student from Talita	UFSC	
11:55	15:55	Round table discussion		
12:05	16:05	Margot Clauss	LTU	Re-use of space debris (tech)
12:10	16:10	Christopher student		
12:15	16:15	Didun Obilanade	LTU/GKN	Project DYKAM
12:20	16:20	Round table discussion		
		Closing discussions		

Taking flight with RISE

Innovair event @ Sweden Innovation Days Jan 19, 2022

Sofia Ohnell

Vice President

Business and Innovation Area Mobility, RISE



For a sustainable future...

- RISE was formed to accelerate Sweden's innovation power.
- Consolidation of >30 research institutes and some 130 unique testbeds.
- The RISE Mission:

*"... to be **internationally competitive** and promote **sustainable growth** in Sweden by strengthening the competitiveness and innovation of trade and **industry**, as well as promote the innovation and capabilities of the **public sector** to contribute to solutions to societal challenges in concert with trade and industry."*



Revenue
3396
MSEK

8
Most attractive
employer
(graduate engineers)

625
Research publications

2025
The year when RISE is
climate neutral




2800
Employees

874
Income from public
financiers (MSEK)

48%
Business income

129
Testbeds and
demonstration
environments

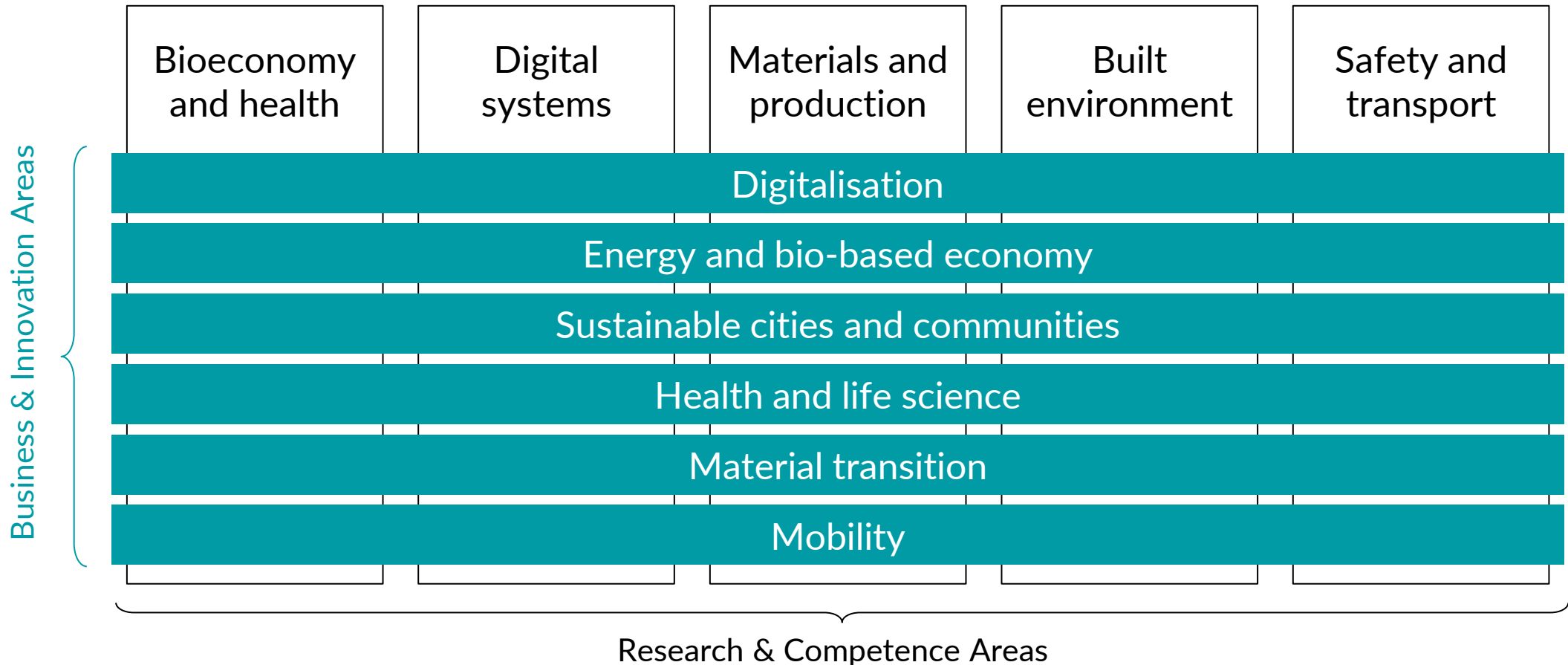


177
Income from
EU projects (MSEK)

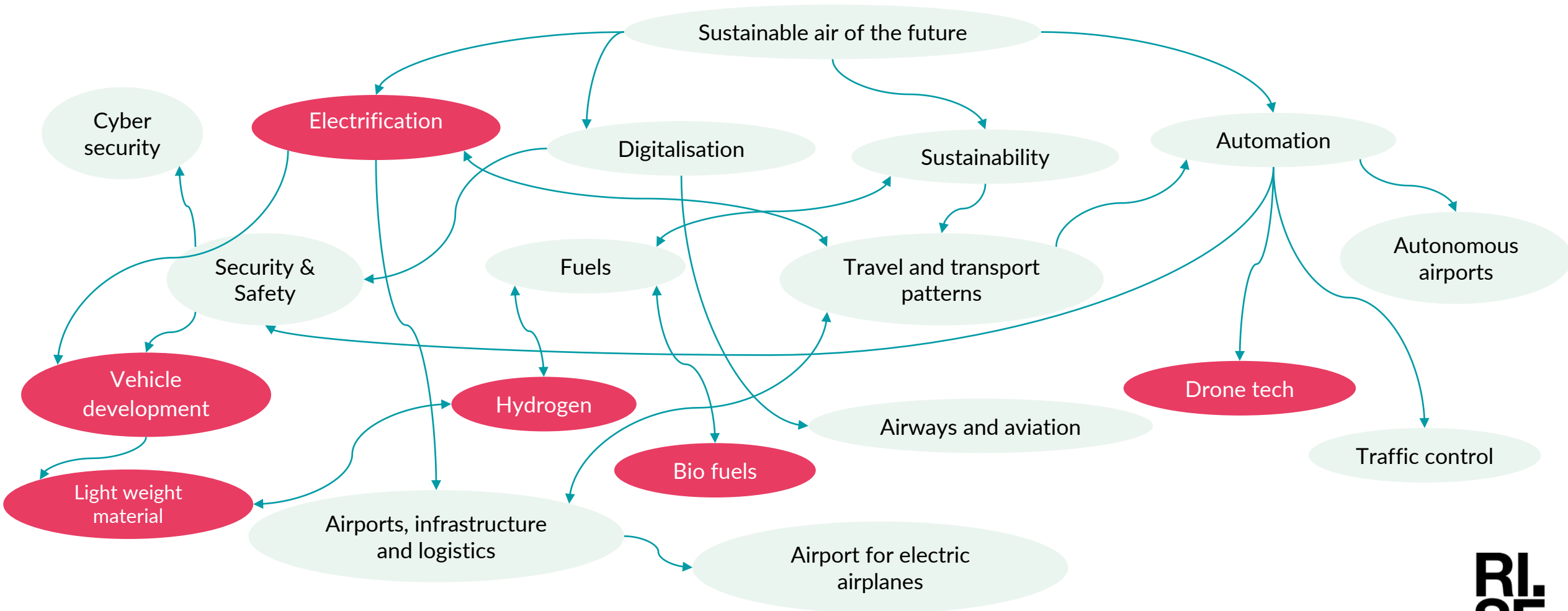
39%
Women

46
New patents

RISE Research and Innovation



RISE Research in Aviation



Nordic Drone Initiative

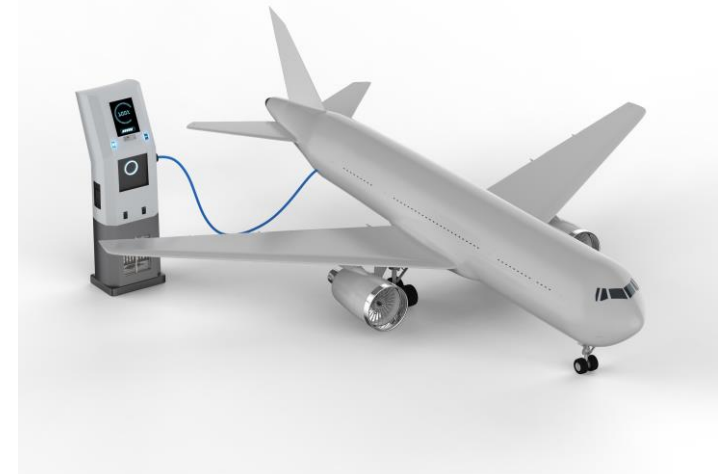
The Nordic Drone Initiative:

- Aims to form a **collaborative innovation platform** to gather **relevant stakeholders** to accelerate the introduction of drone-based transport solutions.
- Led by RISE and consists of 16 partners from four Nordic countries
- Funded by: Nordic Innovation



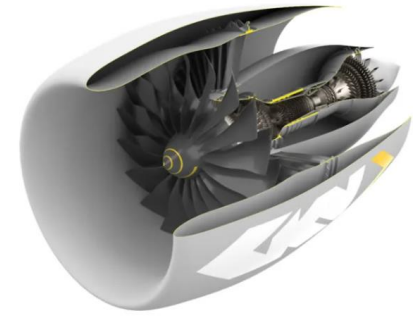
Aeronautical Research in Fossil Free Fuels

- **Biobased fuels:** Using forest-based products, e.g. lignin, wood chips.
- **Electrification:** Prerequisites for charging infrastructure and commercialisation of regional electrified flight connections.
- **Hydrogen:** Storage and propulsion



Projects in Hydrogen & Electrification

- **H2JET:** Development of key components for hydrogen-powered aircraft engines
- **LH2-Tanks:** Design and manufacturing of demonstrator tank for liquid hydrogen tanks
- **Fossil free aviation in northern Sweden:** An implementation study that examines the conditions for flights with biofuels, electricity and hydrogen
- **Funded by:** Energimyndigheten/Swedish Energy Agency



IntDemo

International demonstration

IntDemo Aricraft

- Aims to strengthen the Swedish aviation industry's competitiveness in an international perspective through the development of demonstrators containing new technologies, new methodologies and new working methods
- **Coordinator:** Saab
- **Funded by:** Vinnova

IntDemo Engine

- Aims to develop more environmentally friendly aircraft engines through rational manufacturing technology.
- The research focuses on three engine modules, the fan, low pressure compressor / intermediate housing, and the exhaust module.
- **Coordinator:** GKN
- **Funded by:** Vinnova

Aerospace Cluster Sweden

The Gateway into the Swedish Aerospace Business

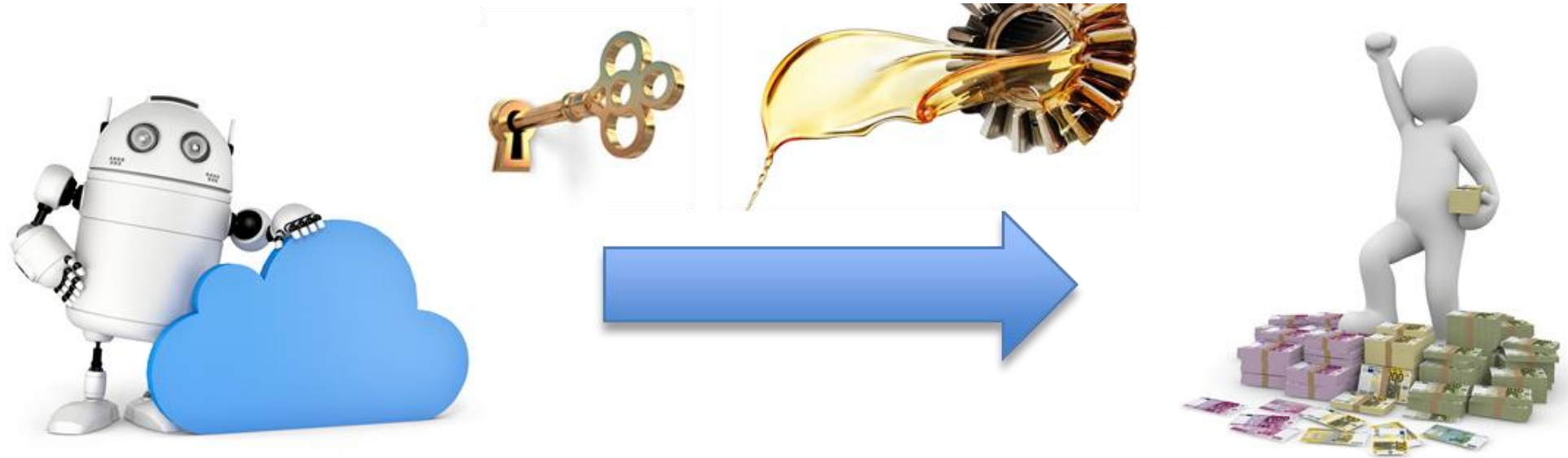
Sweden Innovation Days, Dubai, 220119

Fredrik Olofsson

www.aerospaceclustersweden.com

Aerospace Cluster Sweden (ACS)

AEROSPACE
CLUSTER
SWEDEN

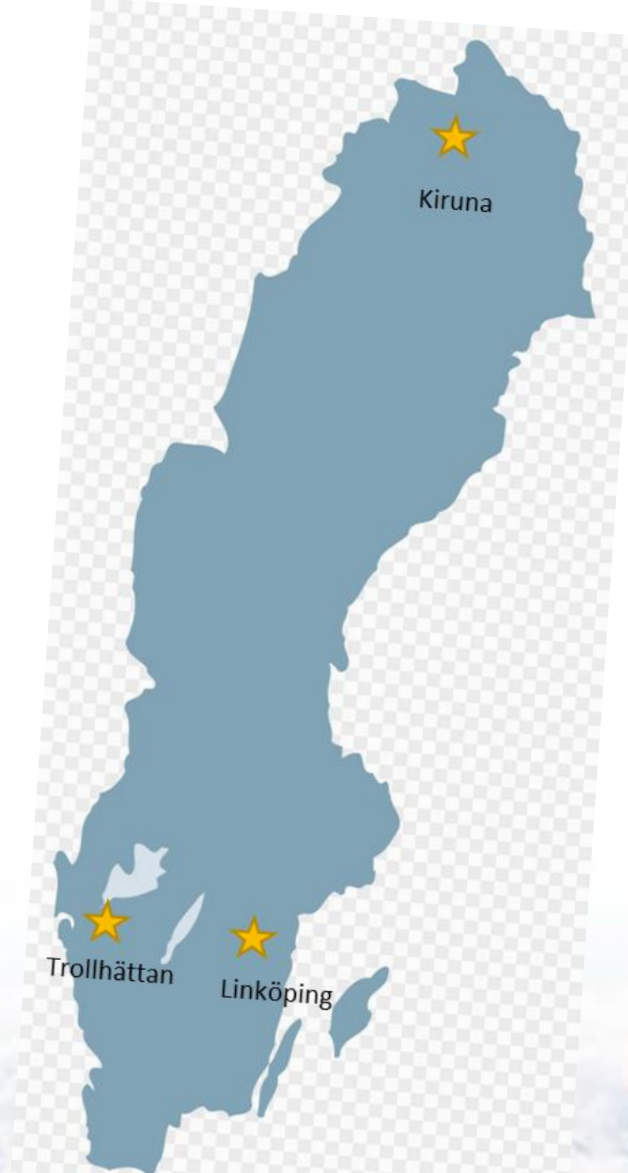


Cluster with the goal to increase the business in the Aviation and Space arena

Focus on Small and Medium-sized Enterprises (SME)
in collaboration with the larger companies, academy and institutes.

www.aerospaceclustersweden.com

- Approximately 50 members
- 3 cluster nodes
 - Linköping (East)
 - Trollhättan (West)
 - Kiruna (North)



www.aerospaceclustersweden.com

ACS Areas of Business

Networking

Exposure

International-ization
(Networking/Exposure)

Policy & Regulations

Support

Competence

www.aerospaceclustersweden.com

THE EACP STRENGTHENS THE POSITION OF THE EUROPEAN AEROSPACE INDUSTRY IN THE WORLD MARKET.

**AEROSPACE
CLUSTER
SWEDEN**

Contacts - The Gateway into the Swedish Aerospace Business



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Cluster Manager North

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GKN Aerospace - An overview

~£3BN
SALES*

41
SITES

4
GLOBAL
TECHNOLOGY
CENTRES

15,000
EMPLOYEES

13
COUNTRIES

ON BOARD
100,000
FLIGHTS A DAY

* 2020 Sales - £2.8bn

Engines – One of three Business Lines

Serving three different Aerospace Markets

Headquarters in Trollhättan, Sweden

Engines Sales
2021 - \$1.2b

~4,000 employees



> Civil

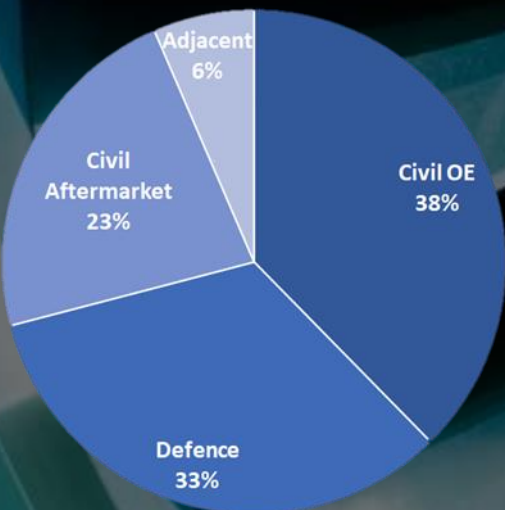
- **Partner in 70% of all active aircraft engines on the market**
- Independent **Partner** with all major OEM's
- OE & Aftermarket

> Defence

- **OEM** for full engine (RM12) world wide supplier of product support (technical and MRO)
- **Partner/Supplier** in sub-systems and components
- Significant content on F135

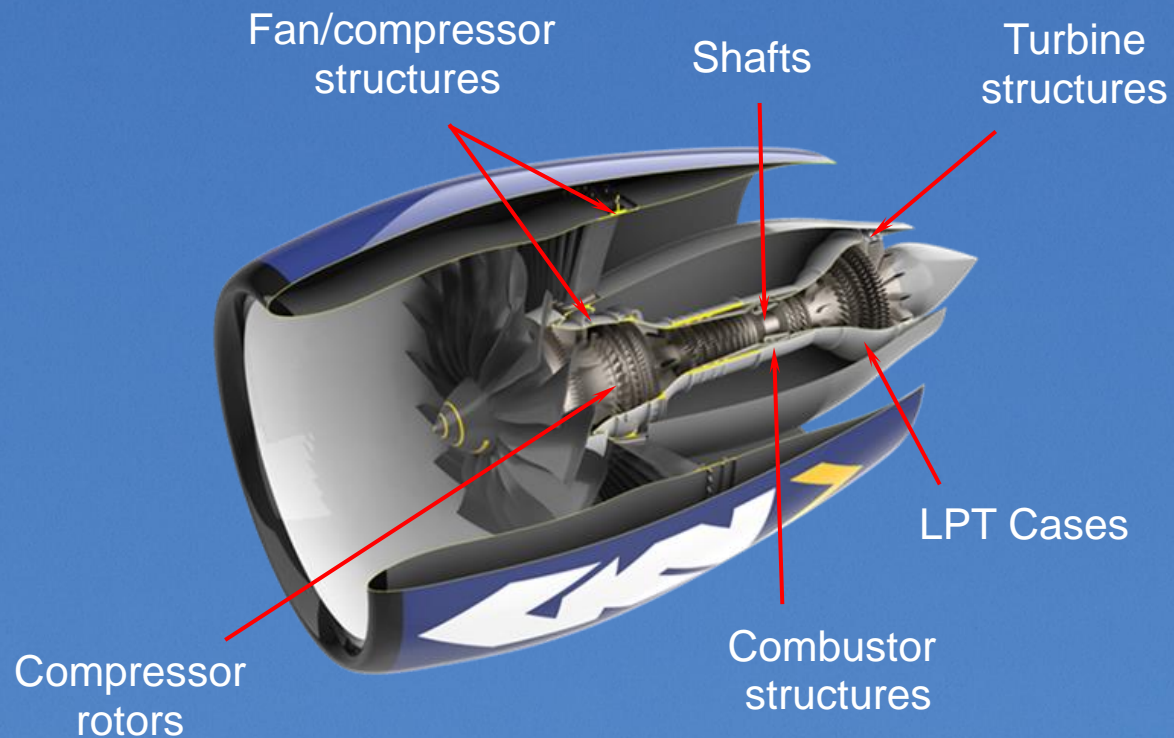
> Adjacent

- Long term **Partner** in the European space community
- **Partner** with Engine OEM's on IGT derivatives
- Synergy with Civil & Defence





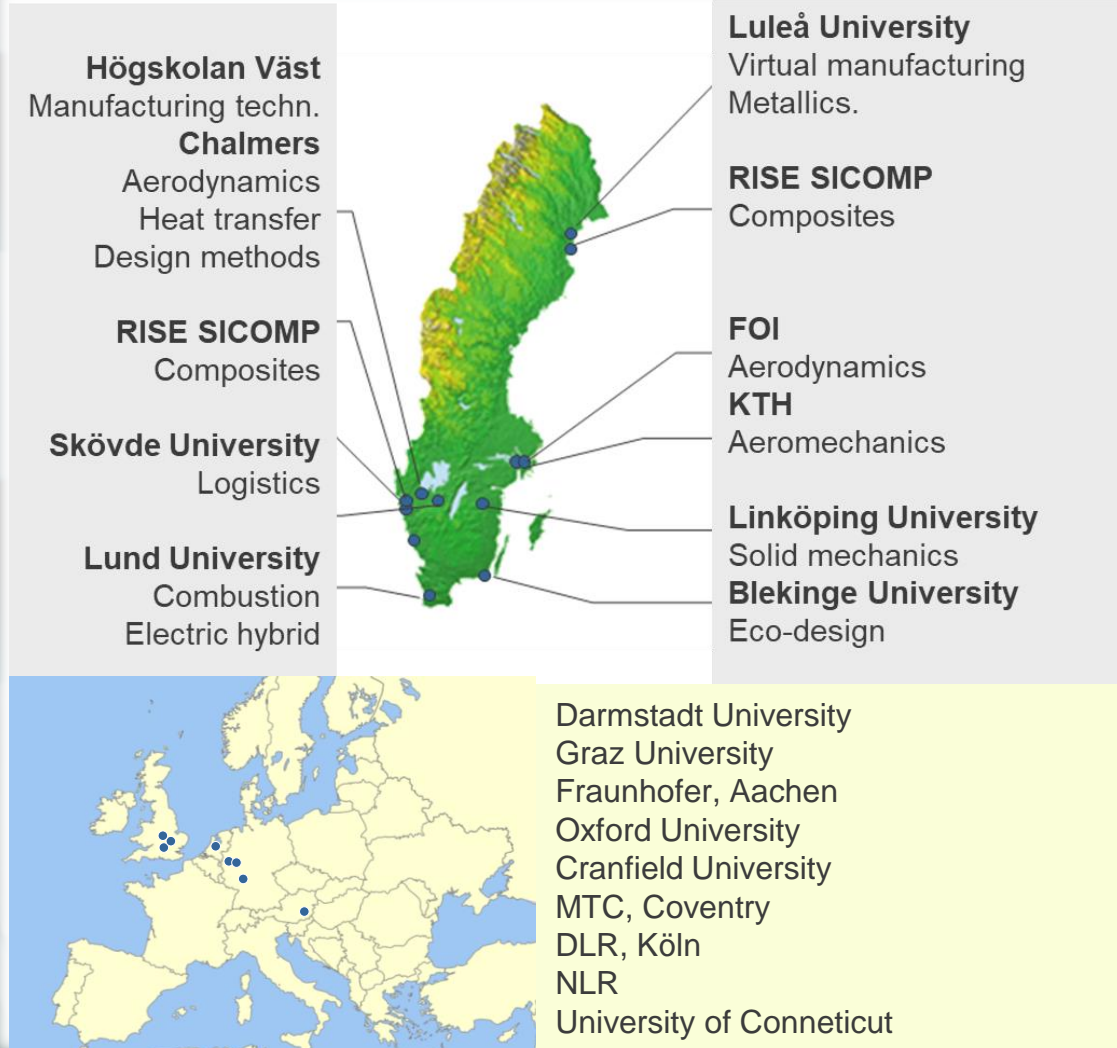
90 % of all modern large
airplanes have components
from GKN Aerospace



- > All fighter engines to the Swedish Air Force since 1930
- > Today we keep the global JAS 39 Gripen fleet available and safe, at all times
- > Partner in Europe's Ariane launcher programme, providing engine sub-systems since 1974

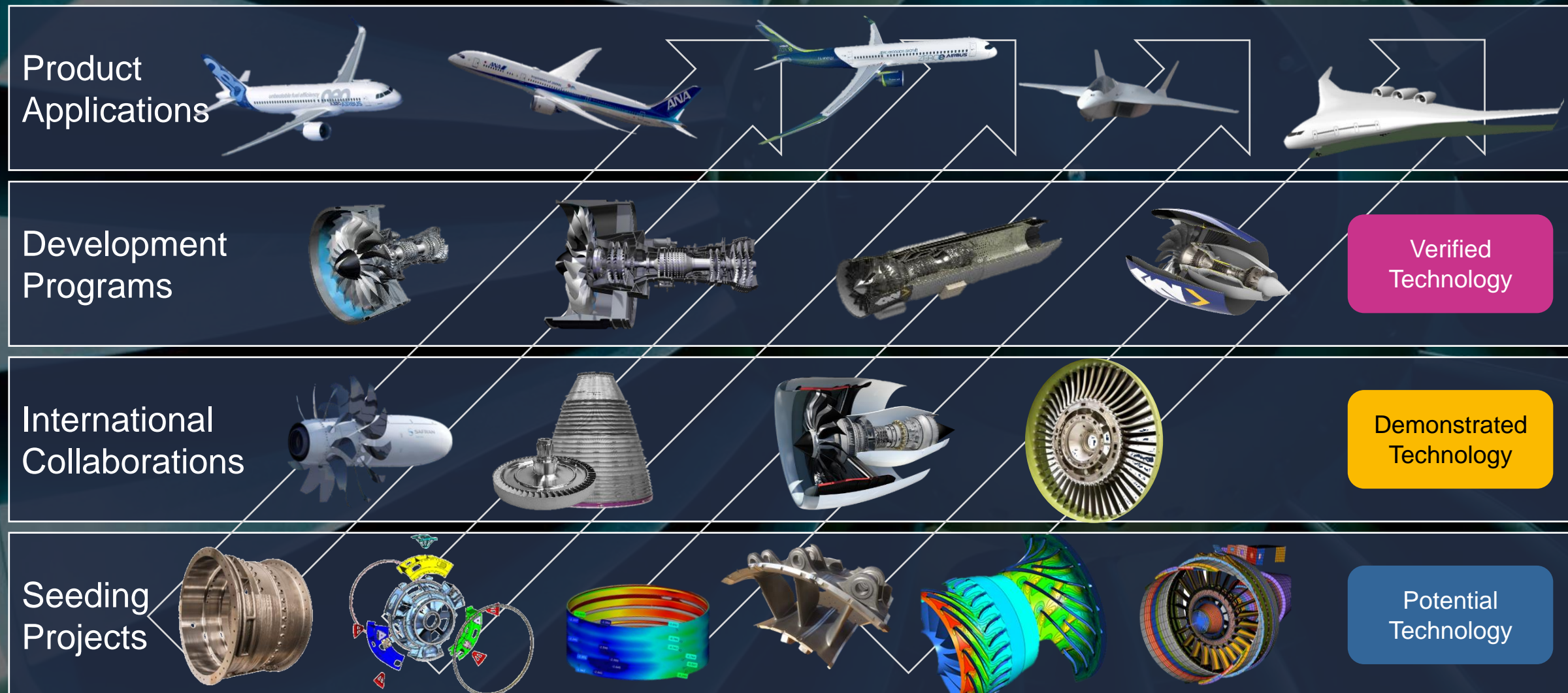


Strong Research and Development



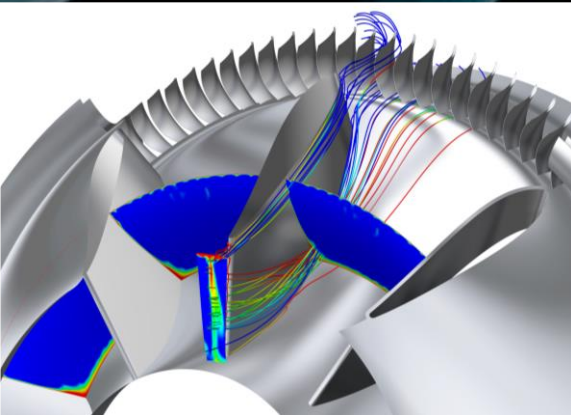
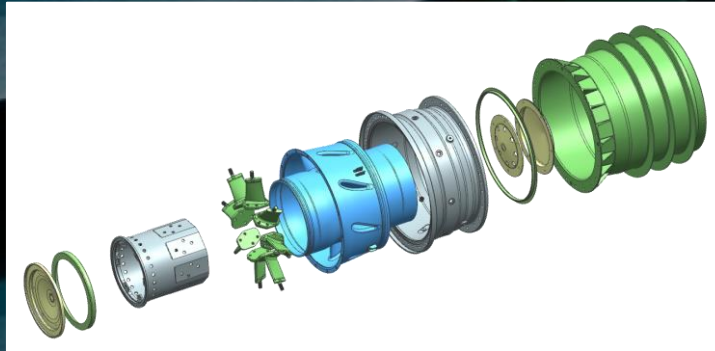
- GKN Aerospace in Sweden is the global technology centre for Engines
- R&D budget approx. 800 MSEK/year
- Approx. 600 R&D engineers
- More than 60 ongoing Ph.D. projects
- The Swedish model is based on cooperation and open innovation arenas. We cooperate with a large R&T ecosystem in Sweden and Internationally

Business Driven Technology Development



European Technology Partner

- > Long term core partner in European Technology programs; Clean Sky 1 & 2
- > Founding member of Clean Aviation
- > Development and demonstration of innovative solutions for best value in partnership with our customers



Some examples of products and projects to reduce CO₂ emissions



- 30% weight



-15% weight +200°C

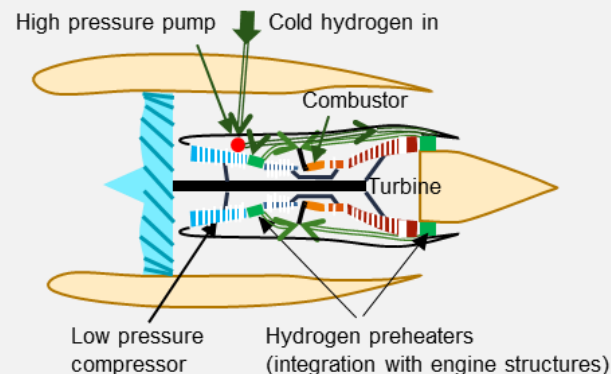


GKN inside

Clean Sky 1: in total -32% CO₂



Hydrogen



An Ambitious Vision for Clean Aviation



Large-scale Additive Deposition

- > **Replacing forgings by near net additive parts**
 - Saves 600kg titanium per part
 - Buy-to-fly 7.5 → 1.5
 - Less environmental impact – est. 68% less CO₂ emissions

thinkGREEN!







SAAB

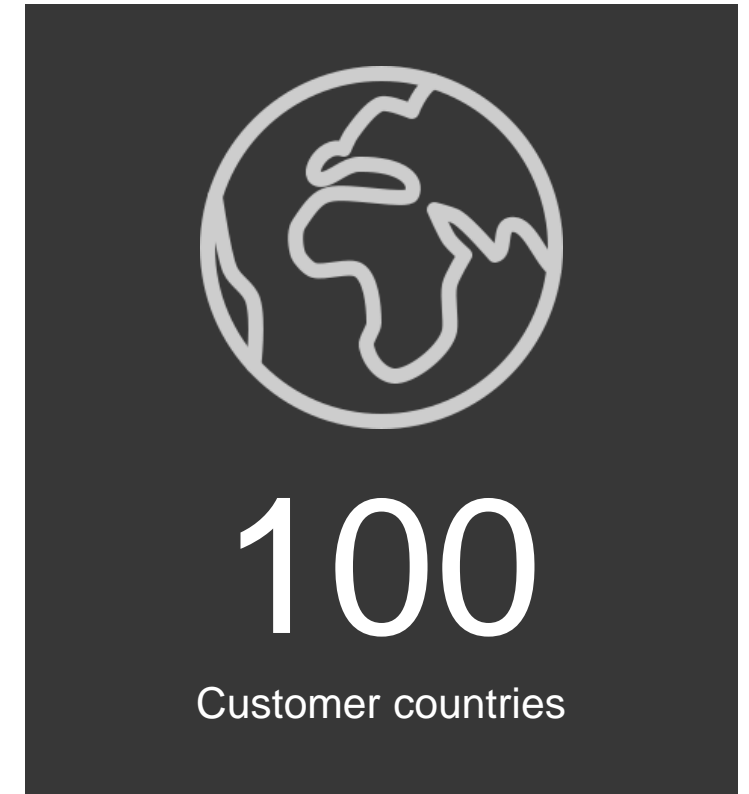
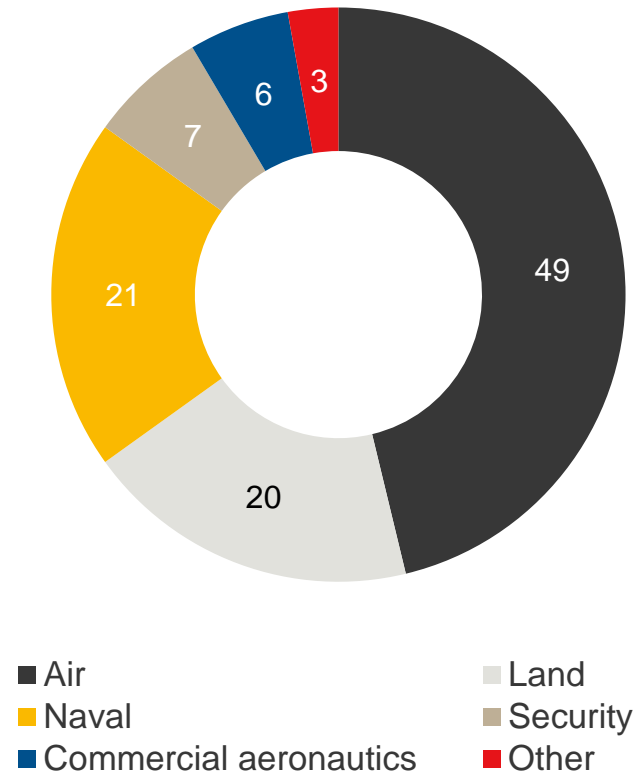
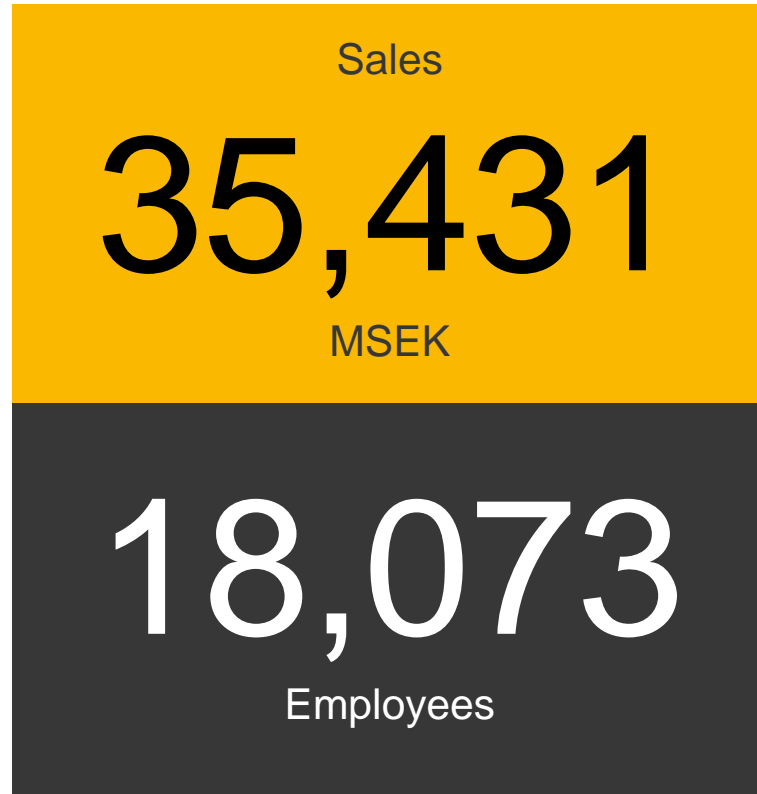
Innovation is our business

Göran Bengtsson

Saab AB, Aeronautics,
Strategy and Business Development



Company overview – 2020





Our broad offering





Saab – Innovation from necessity

- Founded to meet Sweden's defence needs
- Small, neutral country with great needs + limited resources = innovation
- Acquisitions strengthen innovation; including activities of Alfred Nobel (Bofors), Sensis, Ericsson Microwave and Kockums' shipyards
- On our journey we created Sweden's computer, missile and space industries

More than 80 years of experience and over 5500 aircraft built

- A company with aircraft design and production at its core
- Platform, systems, sensors and integration experts
- A product portfolio that contains:

- **Advanced weapon systems**
- **Underwater systems**
- **Command & control**
- **Aeronautics**
- **Sensors**

1937

NOW

>5500
Aircraft built

More than

80

years of
experience





Recent innovations – Gripen E

- The cockpit further develops the Saab principle of sensor fusion and decision support towards the pilot.
- Defines the future in Electronic Warfare (EW) systems on fighters by its complete highly integrated EW suite.
- Eliminates the need for costly and time consuming updates of the Flight Control System.
- New ways of working, internally and with suppliers, reduces production cost significantly.



New complete solution – GlobalEye

- Multi-role, swing-role solution across air, maritime and land domains
- A revolution in high-performance, long-range sensors
- Single platform, multi sensor, multi-mission

Strategy for innovative solutions

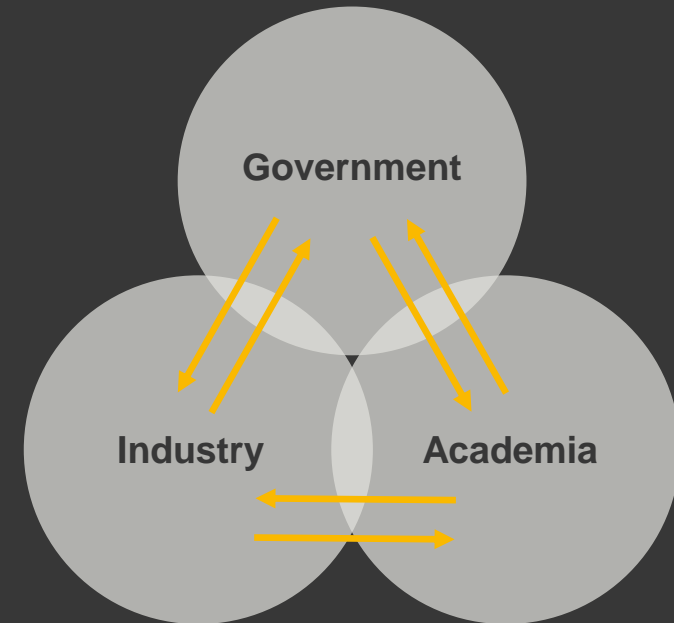
- Come closer to customers in key markets
- Develop innovative solutions in priority areas
- Continue to improve efficiency in product life cycle
- Use systems integration knowledge
- Research collaborations
- Strategic partners for disruptive innovations and technologies
- Continuously develop leaders and employees



Innovation in triple helix collaboration



- Innovation contributes to national economy growth
- Triple helix is an innovation system that fosters results by joining forces between the stakeholders
- Coordinates strategic directions, programs and funding for technology paths in technology areas of joint interest
- Combines and spreads technologies that generate new formats for production and transfer and application of the knowledge base in dual use and multiple use



Triple helix in action – Aerospace

- Innovair is a strategic research area with a national agenda and a strategic research program
- Innovair bases activities on forums, research networks, technical clusters, demonstrators and arenas. They are closely co-ordinated with the National Program for Aerospace Research.
- Innovair and individual actors joins forces in both domestic and international triple helix contexts where cooperation are mutually beneficial.
- Demonstrators are important to handle the middle technology readiness levels costs, risks and uncertainties, maintain and build competencies and share the higher investments at this stage.



Saab Roadmap

INNOVAIR

Product application



Double turnover in aeronautics

Development Programs and Full-scale Demonstrators



NEURON



MIDCAS



Remote technology

TRL 9

Verified Technology

SESAR

SESAR-2

JTI "Clean Sky"

JTI "Clean Sky 2"

FLUD

GF Demo

SWE-Demo

TRL 6

Demonstrators

ALCAS

COALESCE2

LOCOMACHS

SARISTU

MOET

NEFS

A2015

ASHLEY

SCARLETT

ALICIA

CRESCENDO

Triple use

NFFP 3

NFFP 4

NFFP 5

NFFP 6

NFFP 7

TRL 3

Technology

Basic Technologies

2005

2010

2015

2020

Time

Welcome to Stockholm, Sweden

ICAS 2022

33rd Congress of the International Council of the Aeronautical Sciences

4–9 September 2022

Deadline for submitting abstracts: February 10

For updates, see: www.icas2022.com



 **Stockholm**
The Capital of Scandinavia

