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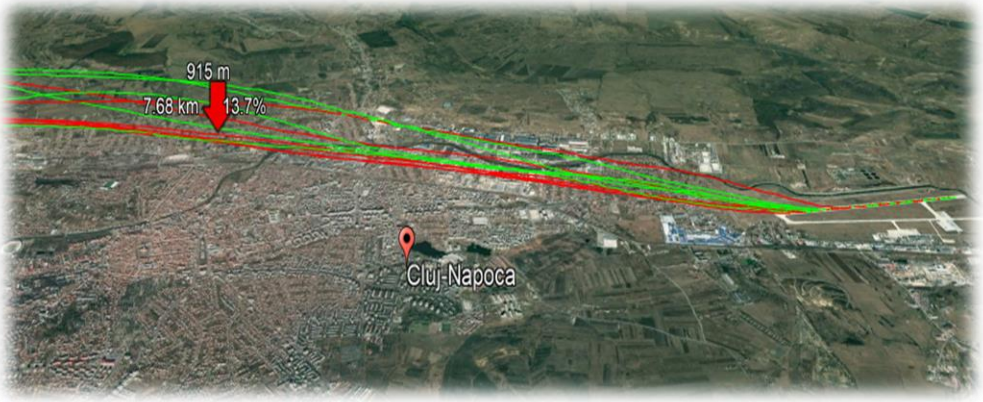
The Significance of the Sustainable Development Goals in the Aviation sector

-from the airport interdependencies to UAM-



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12 October 2020

KTH Centrum för Hållbar Luftfart (CSA)

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Content

- ❑ Sustainable Development Goals
- ❑ Links to Aviation
- ❑ SDGs –relevance
- ❑ UAM
- ❑ Interdependencies- case-studies
- ❑ Conclusions

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The UN SDGs Framework

UN Rio Conference, 2012:
- a **framework** to analyse contribution to **environmental, political and economic challenges**

Sustainable Development Goals (SDGs) -introduced in 2015 (United Nations,). represent the **action plan** aimed at achieving a better and more responsible future.

SD Goals- linked to Agenda 2030

There are **17 Goals** which address a wide range of challenges the world is facing nowadays:

- poverty, inequality,
- climate change, environmental degradation,
- health and well-being, economic growth,
- sustainable cities and communities,
- industry, innovation and infrastructure and… many more

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Impact of COVID-19 & The European Green Deal

The COVID-19 crisis will influence *countries capacities to achieve* the SDGs by 2030.

The COVID pandemic magnifies the impact of inequality, hitting the poor the hardest.

The UN **2030 Agenda** and its **SDGs**, translated into the **national sustainable development strategy**, will be used as *roadmap for a sustainable recovery* from the COVID-19 crisis.

Several call of the EGD call (H2020) are tackling the SDGs.

Transport is a major contributor of global greenhouse gas emissions, it represents 25% of European emissions. EU Member States are looking for solutions to have *cleaner, cheaper and healthier* forms of private and public transport.

EU- ongoing work towards climate-friendly, sustainable and affordable mobility in the transport sector.

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Goal 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation

- Recovery Plan

„Rebuilding Europe": National Investment and Economic Re-launch Plan envisages important transport and environment investments. Among these, important innovations are those that will contribute to reducing the carbon footprint of cities

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SDGs Indicators

- The **17 Goals** presented within Agenda 2030 illustrate a broad focus which can be difficult to quantify.
- A **global indicator framework** for SDGs was developed and agreed upon in 2017 .
- **Indicators** are defined as **markers of progress** or continuity which enable development measurement.
- SDG indicator framework consist of a set of 231 unique indicators structured along all the goals (no indicators yest for UAM integration).
- UN agreed on **refining** the global indicator framework yearly, complementing it by **regional and national** indicators.

The implementation of SDGs and the monitorisation of all targets and indicators takes place at a national level.

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Smart Cities- Airport Cities

A smart city development model features the coexistence and simultaneous integration of the following six pillars:

1.Smart Economy

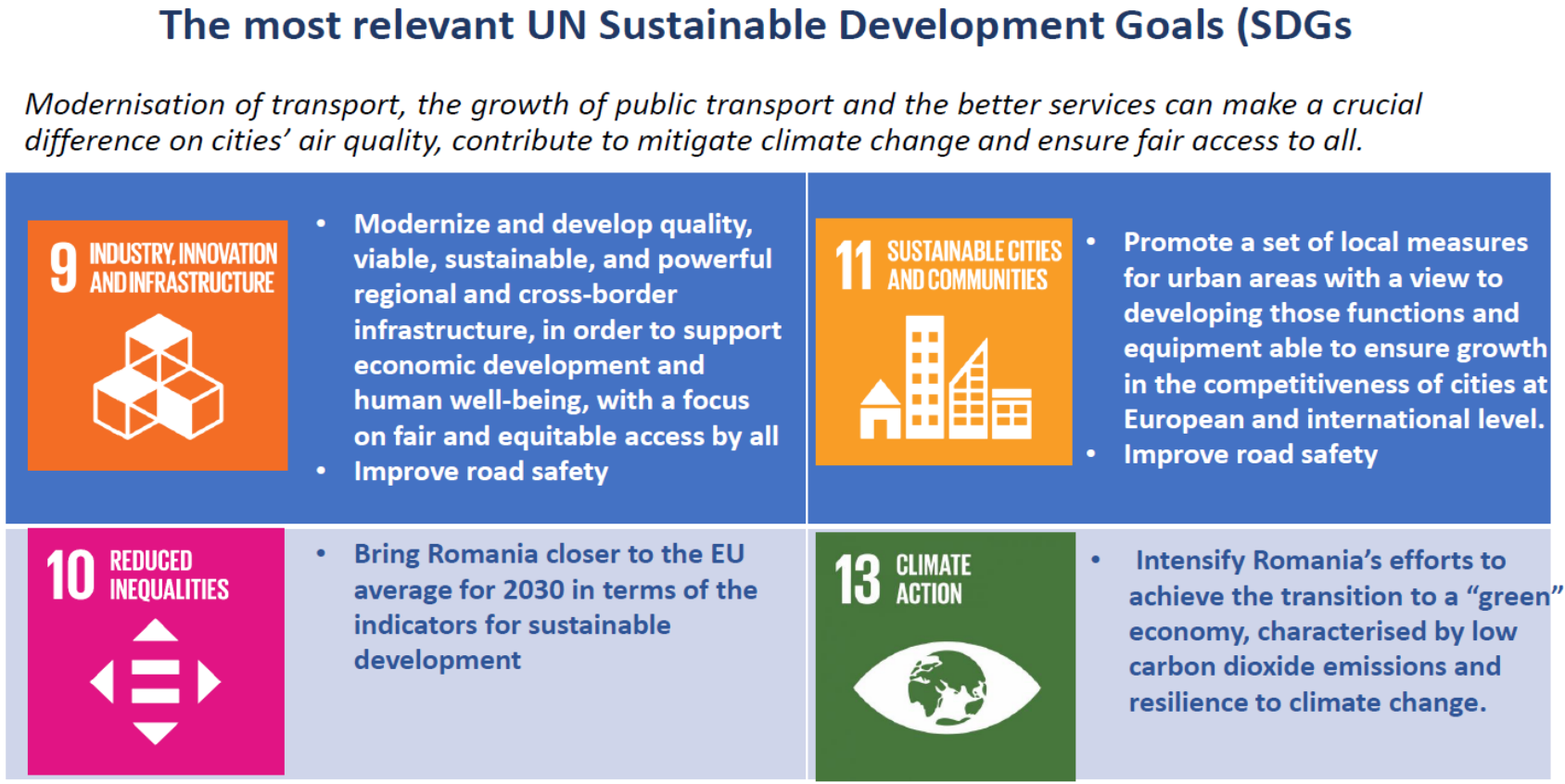
2.Smart Mobility

3.Smart Environment

4.Smart People

5.Smart Living

6.Smart Governance.



SDG, Romania-2020

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SDGs- Targets and Indicators

TARGET 3.6 By 2020, halve the number of global deaths and injuries from road traffic accidents

TARGET 3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air pollution .....

INDICATOR 3.6.1 Death rate due to road traffic injuries

INDICATOR 3.9.1 Mortality rate attributed to household and ambient air pollution

TARGET 7.2 By 2030, increase substantially the share of renewable energy in the global energy mix

INDICATOR 7.2.1 Renewable energy share in the total final energy consumption

TARGET 8.3 Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, ...

INDICATOR 8.3.1 Proportion of informal employment in total employment, by sector and sex

TARGET 9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, ...

TARGET 9.5 Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries

INDICATOR 9.4.1 CO_2 emission per unit of value added

INDICATOR 9.4.1 Researchers (in full-time equivalent) per million inhabitants

TARGET 11.6 By 2030, reduce the adverse per capita environmental impact of cities (special attention air quality)

TARGET 11.b By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards mitigation and adaptation to climate change, resilience to disasters, ...

INDICATOR 11.6.2 Annual mean levels of fine PM (e.g. $PM_{2.5}$ and PM_{10}) in cities (population weighted)

INDICATOR 11.b.2 Proportion of local governments that adopt and implement local disaster risk reduction strategies

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Aviation

Quiet	Clean	Sustainable
Aircraft noise (airframe landing gear)	Aircraft design and optimization to reduce fuel burn and CO_2 emissions	Product end-of-life
Engine (propeller, turbomachinery)	Advanced engine combustor concepts to reduce fuel burn, NO_x and particulate matter	Green manufacturing and maintenance repair and operations (MRO)
Community noise	Sustainable aviation fuels (SAF)	Material of concern
Cabin noise	Optimized navigation and avionics	Recycling

(GARDN, 2019)

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Aviation Commitment to SDGs

- Air transport industry has been **actively involved** in the SDGs action plan, **ICAO** being one of the active participants in the Post-2015 United Nations Sustainable Development Summit where the SDGs were adopted under Agenda 2030.
- ICAO expresses its **commitment to SDGs** by aligning its strategic objectives to 15 SDGs (ICAO, 2015).
- Apart from the **strategic considerations and agreed policies**, air transport industry has taken a step further towards **sustainable development** by setting-up several ***independent coalitions*** such as the Air Transport Action Group (**ATAG**).
- **ATAG** created a special platform: "***Aviation: Benefits Beyond Borders***" which aims at providing clear information about the impact aviation has on environment. This website holds detailed information on aviation contribution to SDG (https://aviationbenefits.org/)

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Relevant SDGs for Greening the Aviation Sector

TARGET

4.7. *— By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of*

TARGETS

7.A. *— By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.*

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Relevant SDGs for Greening the aviation sector (2)

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

TARGETS

9.4. *— By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.*

9.5. *— Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in*

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

TARGETS

12.2. *— By 2030, achieve the sustainable management and efficient use of natural resources.*

12.4. *— By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment.*

12.6. *— Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle.*

12.8. *— By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature.*

17 PARTNERSHIPS FOR THE GOALS

TARGETS

17.14. *— Enhance policy coherence for sustainable development.*

17.16. *— Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries.*

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Relevant SDGs for Aircraft Noise Reduction

3

GOOD HEALTH AND WELL-BEING

Ensure healthy lives and promote well-being for all at all ages.

4

QUALITY EDUCATION

TARGETS

4.7. *— By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of*

9

INDUSTRY, INNOVATION AND INFRASTRUCTURE

TARGETS

9.5. *— Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending.*

17

PARTNERSHIPS FOR THE GOALS

TARGETS

17.16. *— Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries.*

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SDGs Technologies for low emissions technologies

3

GOOD HEALTH AND WELL-BEING

TARGETS

3.9. *— By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.*

7

AFFORDABLE AND CLEAN ENERGY

TARGETS

7.A. *— By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.*

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SDGs Technologies for low emissions technologies (2)

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

TARGETS

9.5. *— Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research*

11 SUSTAINABLE CITIES AND COMMUNITIES

TARGETS

11.6. *— By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.*

INDICATORS

11.6.2. *— Annual mean*

13 CLIMATE ACTION

Take urgent action to combat climate change and its impacts.

17 PARTNERSHIPS FOR THE GOALS

TARGETS

17.16. *— Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the*

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SDGs Relevance for New Innovative Areas

7 AFFORDABLE AND CLEAN ENERGY

TARGETS

7.1. *— By 2030, ensure universal access to affordable, reliable and modern energy services.*

INDICATORS

7.1.2. *— Proportion of population with primary reliance on clean fuels and technology.*

TARGETS

7.2. *— By 2030, increase substantially the share of renewable energy in the global energy mix.*

INDICATORS

7.2.1. *— Renewable energy share in the total final energy consumption.*

7.3 *— By 2030, double the global rate of improvement in energy efficiency.*

INDICATORS

7.3.1. *— Energy intensity measured in terms of primary energy and GDP.*

TARGETS

7.A. *— By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.*

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

TARGETS

9.4. *— By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.*

9.5. *— Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending.*

INDICATORS

9.5.1. *— Research and development expenditure as a proportion of GDP.*

9.5.2. *— Researchers (in full-time equivalent) per*

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SDGs Relevance for New Innovative Areas (2)

11 SUSTAINABLE CITIES AND COMMUNITIES

TARGETS

11.6. *– By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.*

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

TARGETS

12.2. *– By 2030, achieve the sustainable management and efficient use of natural resources.*

12.5. *– By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.*

12.6. *– Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle.*

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SDGs Relevance for Raising Awareness on the Impact of Air Travel

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SDGs Relevance for the Aviation Environmental Impact

- Goal 3 noise, emissions/AQ;
- Goal 7 renewable energy; battery technology
- Goal 9 infrastructure; innovations
- Goal 11 integration in city mobility, infrastructure
- Goal 13 fuel efficiency; CO2 impact on Climate Change
- Goal 17 integration with other goal; identify gaps and barriers

Need to consider aviation **integration** in low carbon transport and mobility: UAM (urban air mobility)

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The Relevance of Sustainable Development Goals to Urban Air Mobility Deployment

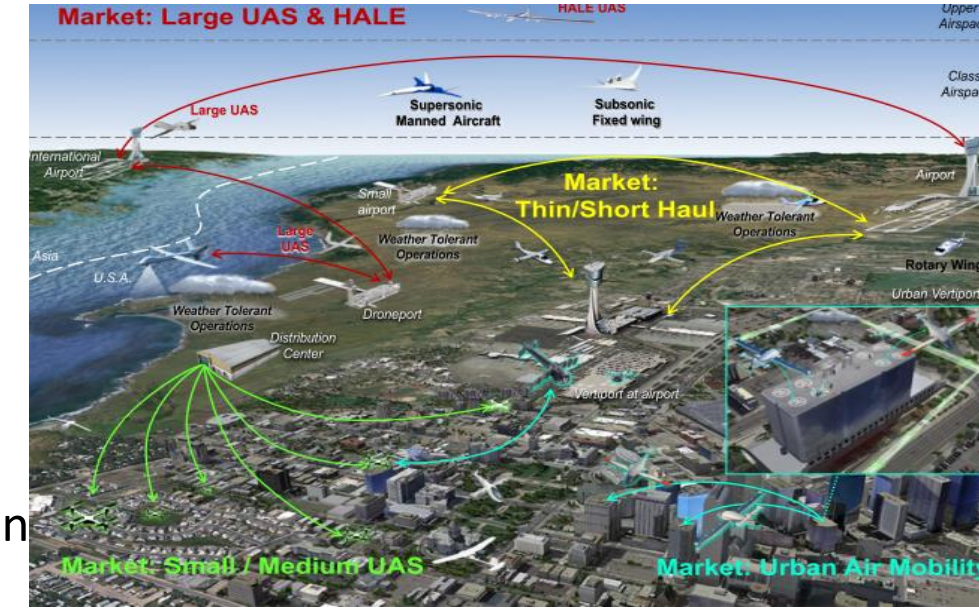
Urban air mobility _ The rise of a new mode of transportation: persons or goods via flying vehicles over urban areas – a new industry

Background:

- *advances in electric propulsion*;
- *autonomous flight technology*
- *5G communication networks*;

On-demand air taxi services,

- scheduled airport shuttles *and*
- intercity flights.



Urban air mobility adds **a third dimension** to the urban transportation

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Expectations from UAM

Integrated Mobility Solution!!

- will mark a major step forward from the complex, *disjointed mobility* chains we know today.

EG: calling a ride-hailing service to pick up and bring the passenger to the eVTOL hub, as well as buying a subway ticket for the last-mile journey at the other end .

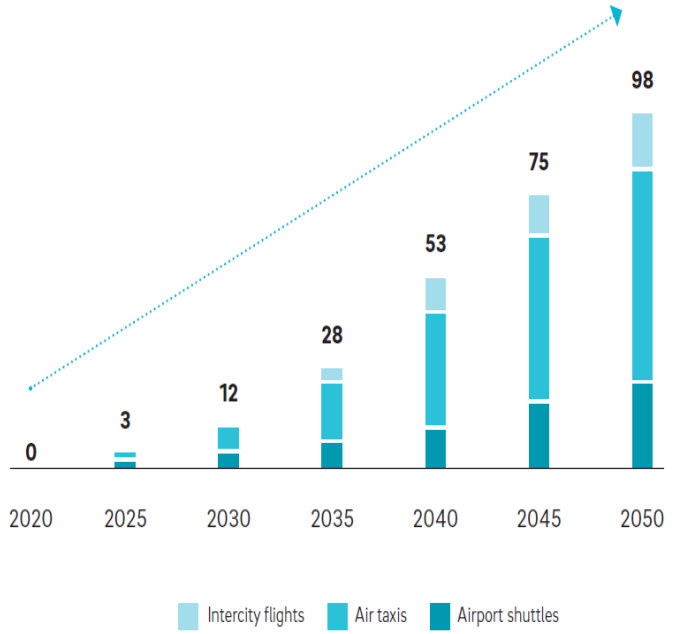
Existing initiatives:

Uber Elevate in United States (US), ***Airbus*** in Brazil,

Volocopter in United Arab Emirates or ***Lilium*** in Germany

A: Passenger drone operations forecast

Number of passenger drones in UAM operation worldwide ['000]



Note: Estimated that ~100 cities will have UAM operations in 2050
Source: Roland Berger

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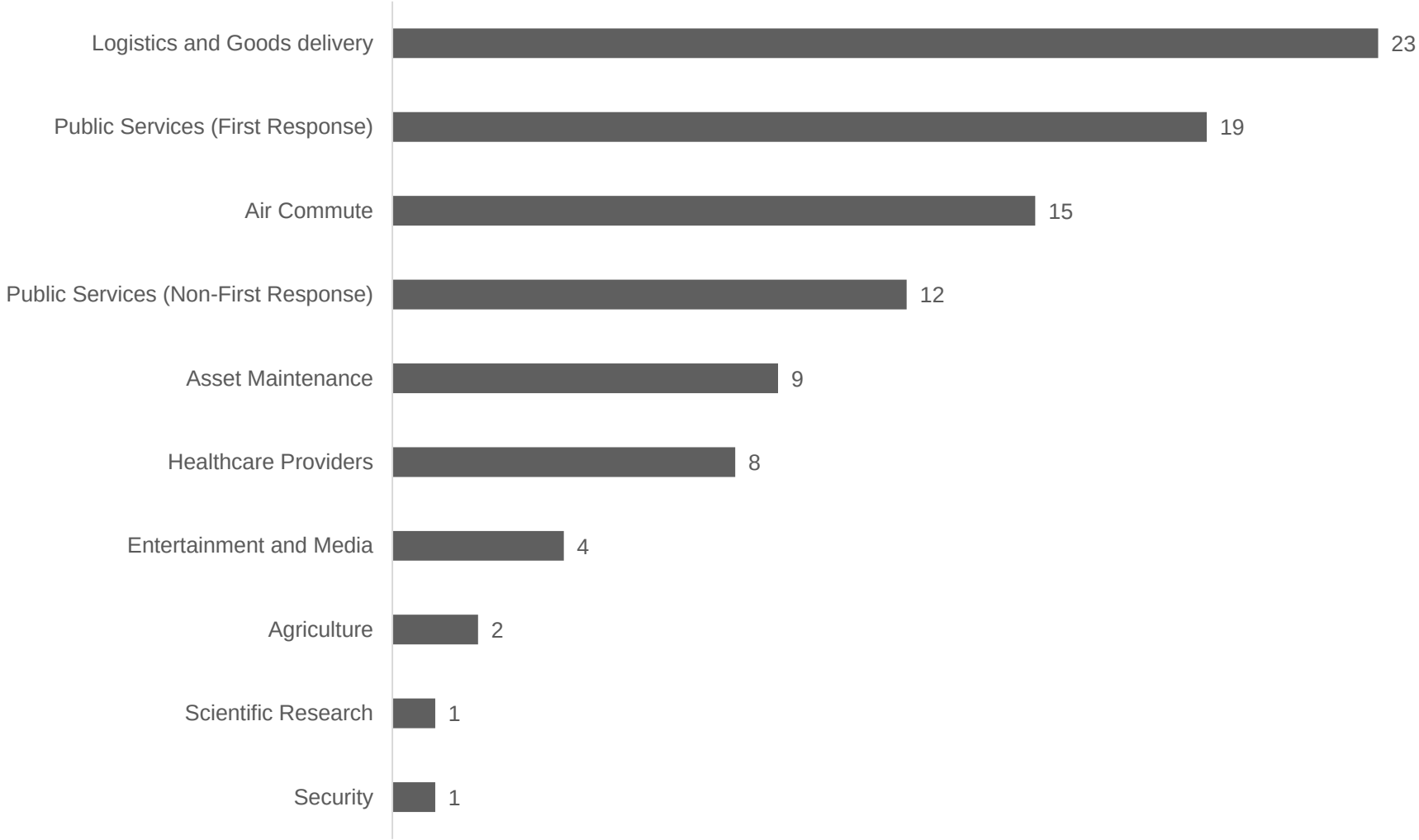
Global distribution of UAM Use-cases

Total UAM Use-cases 2019



Dioane, 2020; MSc thesis Cranfield University

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Environment

- Hybrid & electric aircraft = zero to lower emissions
- Vertical Takeoff and Landing (VTOL) aircraft have been investigated extensively for these operations, but suffer from shortcomings related to **rotor noise** and overall vehicle efficiency
- Suitable airpark locations are then identified by analysing cadastre and **land-use** data

Environmental impact

- Noise footprint
- Emissions/ CC & AQ

In the very long-term, beyond the timescale considered, *energy consumption per person* will limit the use of air transport.

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Noise Remains a Challenge!!

- The next key design driver for any urban air taxi is the noise signature.
- UAM need to be designed and operated in a way that strictly limits the **noise level audible on the ground**.
- The generated noise should be subjectively **non-disturbing**
- Public acceptance- noise & visual impact- remains a big challenge!

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UAM- Challenges and the Impact

- UAM integration **challenges** range from ***operational, regulatory, infrastructure and safety*** issues to ***environmental impact and social acceptance***
- These factors have been researched intensively in the last years with the aim of *modelling the UAM impact*

The relevance of UAM deployment to SDGs represents a key research area that can unlock the implementation of UAM ! The integration in the urban mobility is the key!

UAM acceptance: create innovative solutions to societal problems.

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Contribution of existent UAM use-cases to SDGs

UN SDG		UAM Use-cases		
3	**Good Health and Well-being**	Logistics and Goods delivery	Public Services (First Response)	Healthcare Providers
7	**Affordable and Clean Energy**	Logistics and Goods delivery	Air Commute	Scientific Research
8	**Decent Work and Economic Growth**	Logistics and Goods delivery	Entertainment and Media	
9	**Industry Innovation and Infrastructure**	Logistics and Goods delivery	Air Commute	Asset Maintenance
11	**Sustainable Cities and Communities**	Logistics and Goods delivery	Air Commute	Public Services (Non-First Response)
13	**Climate Action**	Logistics and Goods delivery	Air Commute	Scientific Research
17	**Partnerships for the goals**	Public Services (First Response)	Public Services (Non-First Response)	Scientific Research

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The Research Opportunities

- Define the *concepts of SDGs* for UAM and identify UAM deployment challenges
- Assess the contribution of existent UAM use-cases to SDGs
- *Engage key stakeholders* in sharing expertise in UAM, conceiving an accurate and reliable picture of sustainable aspects relevance to UAM deployment
- Model a potential UAM use-case in Sweden/UK, as part of the SDGs action plan.

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SDGs and Aviation Noise and Emissions Interdependencies

Background

Considering interdependencies or trade-offs of the proposed action(s) and/or alternatives is important when **using results to inform decision making**, or ***conducting an environmental assessment***, to avoid, where possible, any unintended consequences.

ANIMA case-study: preliminary results; https://anima-project.eu/2020/03/anima-project-at-aerospace-europe-conference-2020-outcomes/

The identified research questions & anticipated outcome

- Can ANIMA research contribute to **a better understanding** and **added knowledge** to the concept of interdependencies?
- Are there additional metrics and tools to help the implementation process?

Partners involved: NLR, MMU & ANOTEC

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Methodology

Airport survey (current practices)

- Evidence of the importance of interdependencies to the development and implementation of Balanced Approach (BA) interventions
- Examples of metrics and tools used to assess interdependencies
- How interdependency assessment outcomes informed decision-making
- Stakeholder pressure to consider interdependencies
- Reaching consensus on environmental outcomes – how decisions are made in the light of potentially competing priorities
- **5 airports out of 13 case-studies**

Academic study

- provides a systematic literature review
- *briefly* tackles policy review which supplements the airport survey

Catania Airport case study

- a mix methodology to collect ***airport data***

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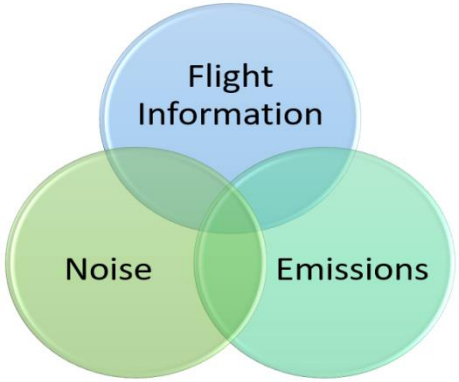
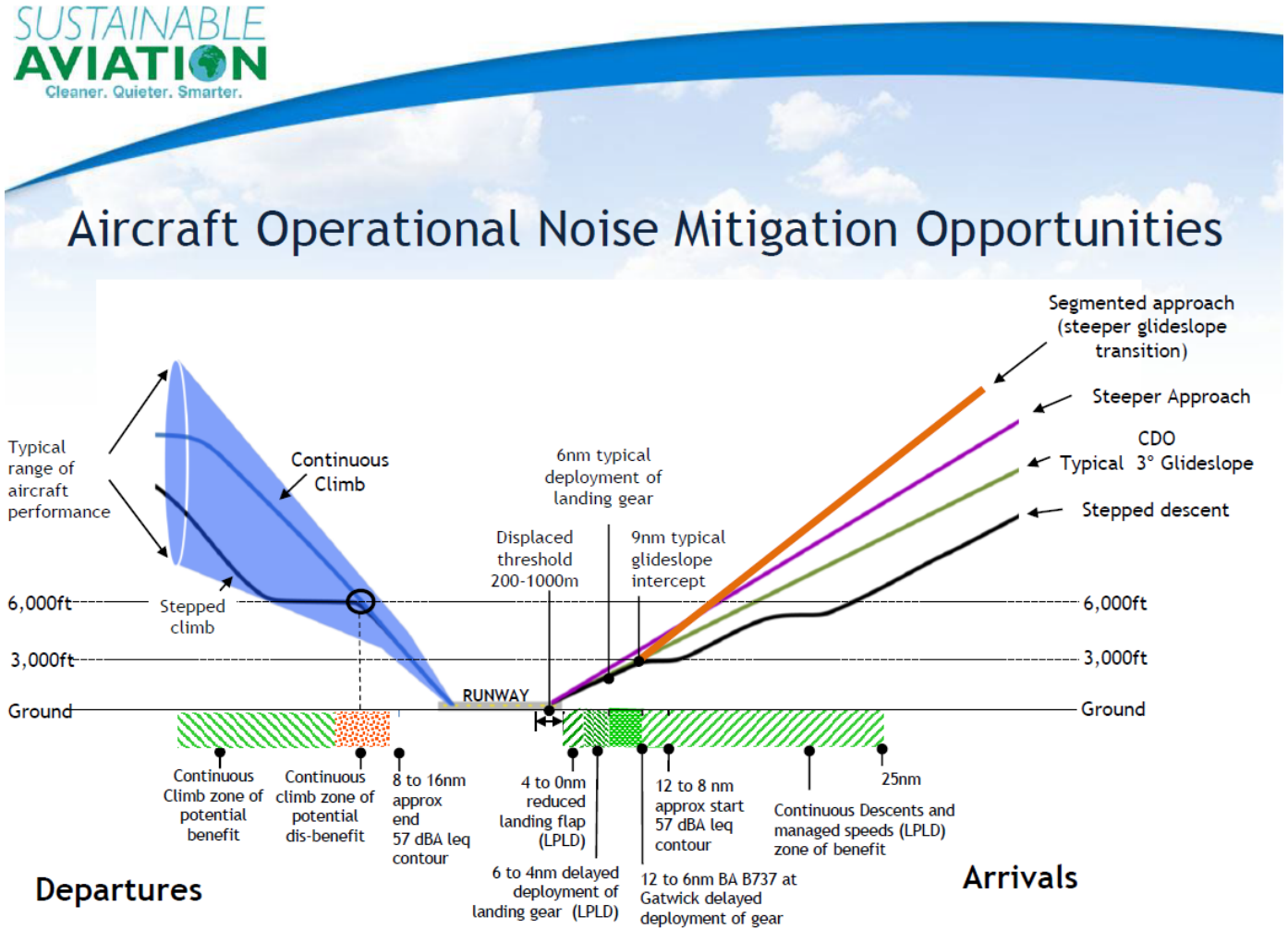
Interdependencies in the airport context

- *Stakeholders involved…*
- *Operational procedures*





Findings

-noise and emissions are frequently considered ***independently*** and not in a holistic way

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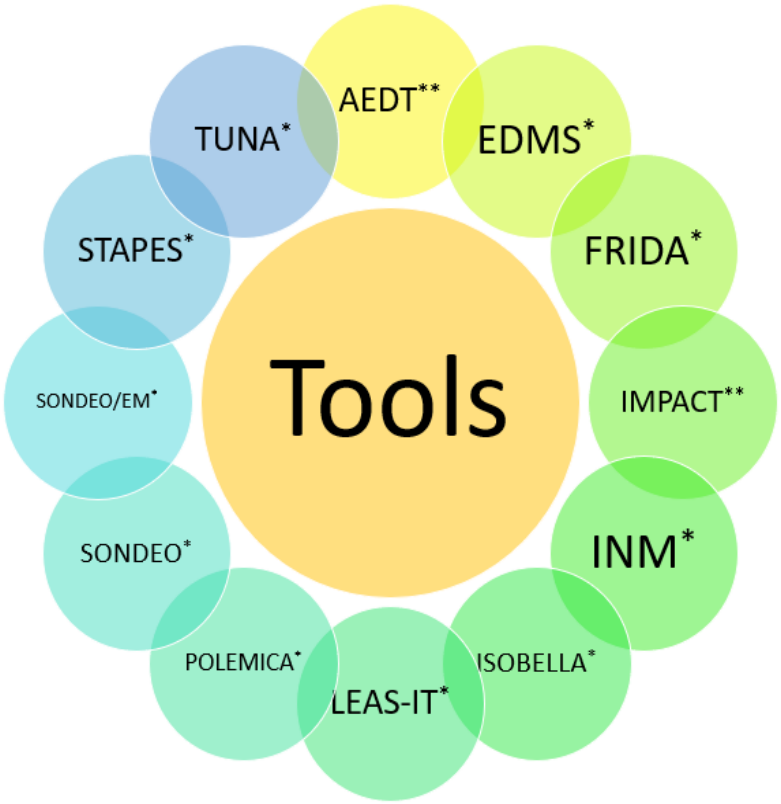
Tools



Source: ANIMA, D2.7, 2020

*Used for noise OR emissions
**Used for noise AND emissions

AEDT— Aviation Environmental Design Tool (Federal Aviation Administration)
EDMS— Emissions and Dispersion Modelling System (Federal Aviation Administration)
FRIDA (University Roma Tre)
IMPACT (EUROCONTROL)
INM— Integrated Noise Model (Federal Aviation Administration)
ISOBELLA (National Aviation University, Ukraine)
LEAS-iT (Royal Netherlands Aerospace Centre)
POLEMICA (National Aviation University, Ukraine)
SONDEO (ANOTEC Engineering)
SONDEO/EM (ANOTEC Engineering)
STAPES— System for Airport Noise Exposure Studies (EUROCONTROL)
TUNA (Royal Netherlands Aerospace Centre

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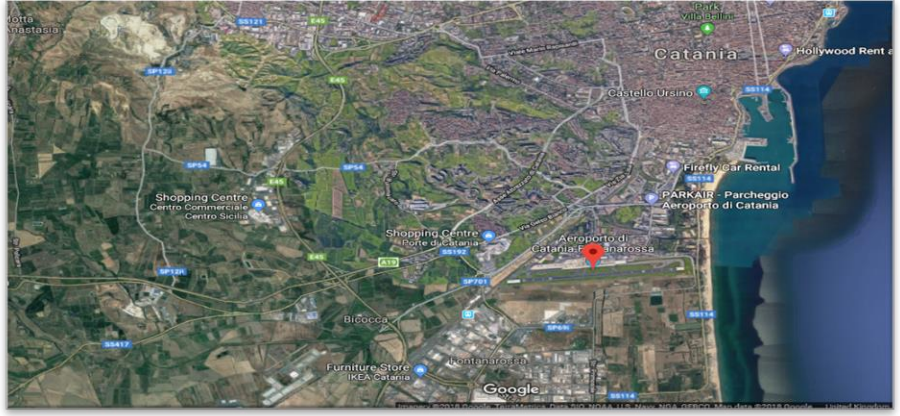
Catania Airport case study



Catania-Fontanarosssa Airport, Google maps- Dec. 2018

Case study objectives

- conduct research **using real airport data**
- involve ANIMA partners tools
- explore a 'learning by doing' exercise
- contribute to the Best Practice Portal

ANOTEC case- study

- ANOTEC analysis aimed at providing insight in the day-to-day variations in noise and emissions that occur while operating a single city-pair by a single operator; **develop a methodology;** use data for SONDEO/SONDEO EM - validation the toolsuit

NLR study

- NLR analysis of the Catania data was to ***investigate the potential*** for a trade-off between noise and emissions of four departure procedures

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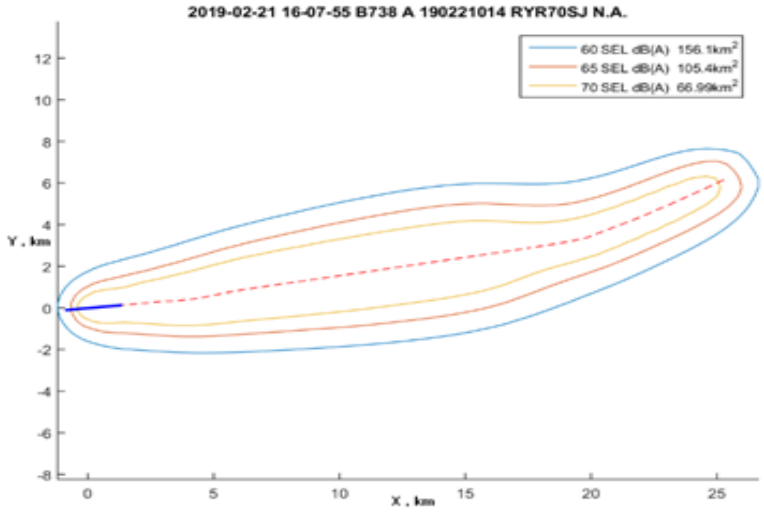
Results (1)

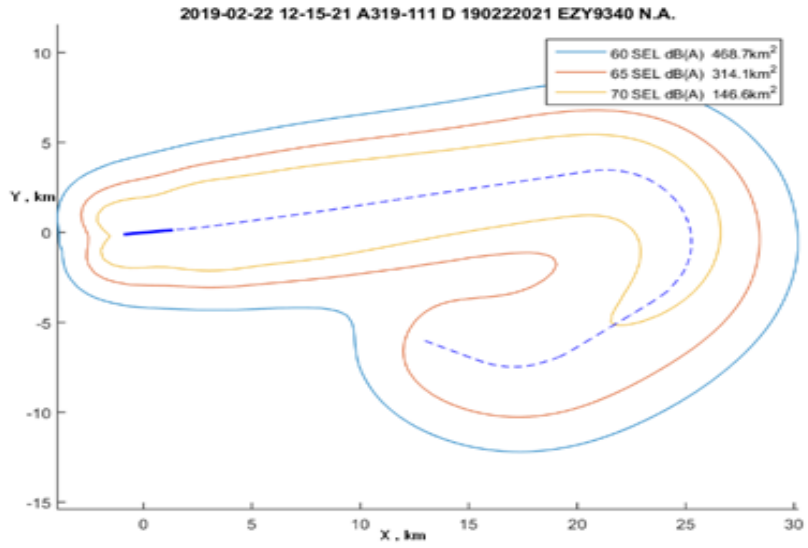
ANOTEC illustration of data problems with the *departure profile*, Feb 2019

The importance of real/accurate data.

- To demonstrate the capabilities of the tool chain, an assessment has been worked out in more details- SONDEO/ SONDEO-EM

Noise and emissions were calculated both, but with ***different models***. This illustrates there are still limitations in current tools to address both noise and emissions in an integrated way and to assess interdependencies.





Noise contours, calculated for the updated dataset from the ANOTEC receiver for two different aircraft (B738, A319)

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Results (2)

NLR analysis was to demonstrate **trade-off potential.**

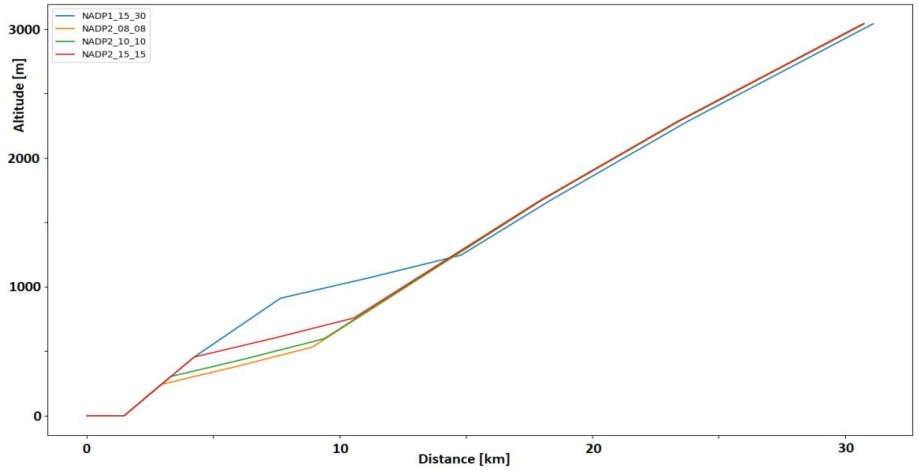
- **Profiles**: calculate flight profiles (speed, altitude, thrust as function of distance) for four different ANP procedures, and compare these to the average profile in the Catania dataset
- **Methodology**: describe the applied methodology for assessing noise and emissions

Results: The ***impact of procedure choice*** on noise and emissions is investigated and presented as *trade-off*. The idea is to provide the airport with an example of a choice between possible procedures

- **Noise modelling** has been calculated using INM software

a 45 dB contour at Catania corresponds to 55 dB contour at an airport with tenfold traffic.

- **CO_2 and NO_x emissions** were calculated along the flight paths for each of the considered profiles.



Examples of four NADP procedures (NLR, March 2019)

The chosen NADP profiles have different cutback and acceleration altitudes, and therefore the *NADP profiles show different altitudes and speeds at the same time instance and distance from airports*

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Gaps Identified

Interdependencies are not in focus ! Information fragmented. Need to be brought together to inform stakeholders on **interdependencies potential**

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An investigation of interdependencies at Cluj-Napoca "Avram Iancu" Airport

Aim of the study

- Perform an analysis regarding interdependencies (noise and emissions) and their ***impact on Cluj-Napoca city***
- Interdependencies analysed for NADP1* and NADP2*

COMOTI ROMANIAN RESEARCH & DEVELOPMENT INSTITUTE FOR GAS TURBINES

Aeroportul Internaţional Avram Iancu Cluj

Blue Air

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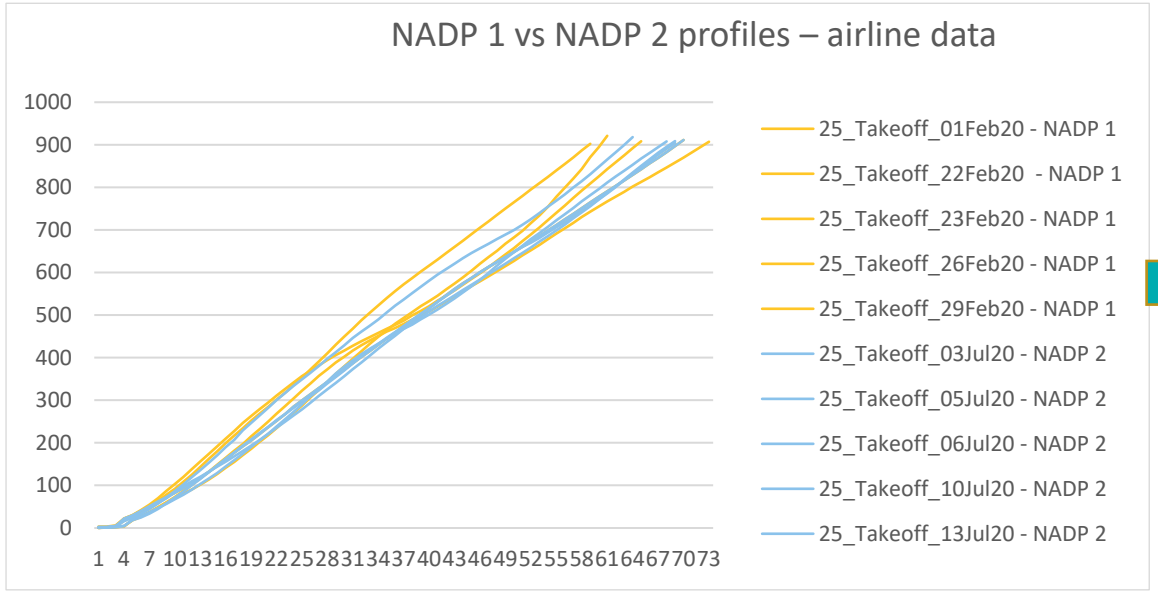
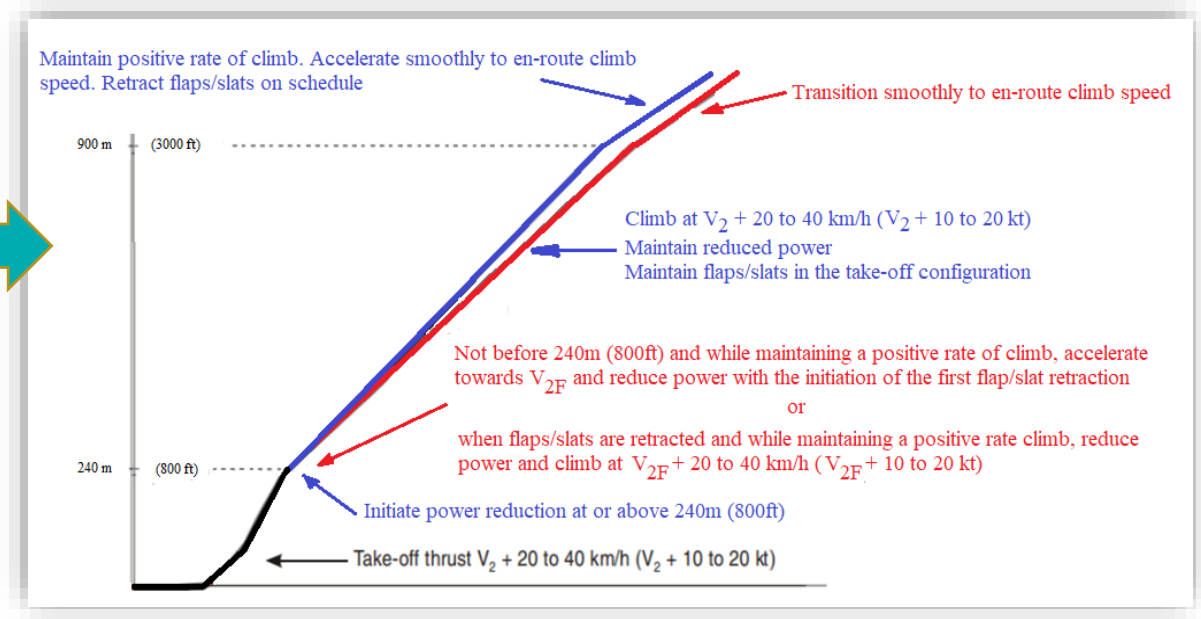
Input –Airline Data





- 2 overall data sets for NADP
  - February, 2020: 5 real track data sets for NADP1
  - July, 2020: 5 real track data sets for NADP2
- Aircraft type – B737-8K5
- Engine type – CFM56 – 7B26/3
- Wind characteristics – data from February, 2020

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Noise Assessment

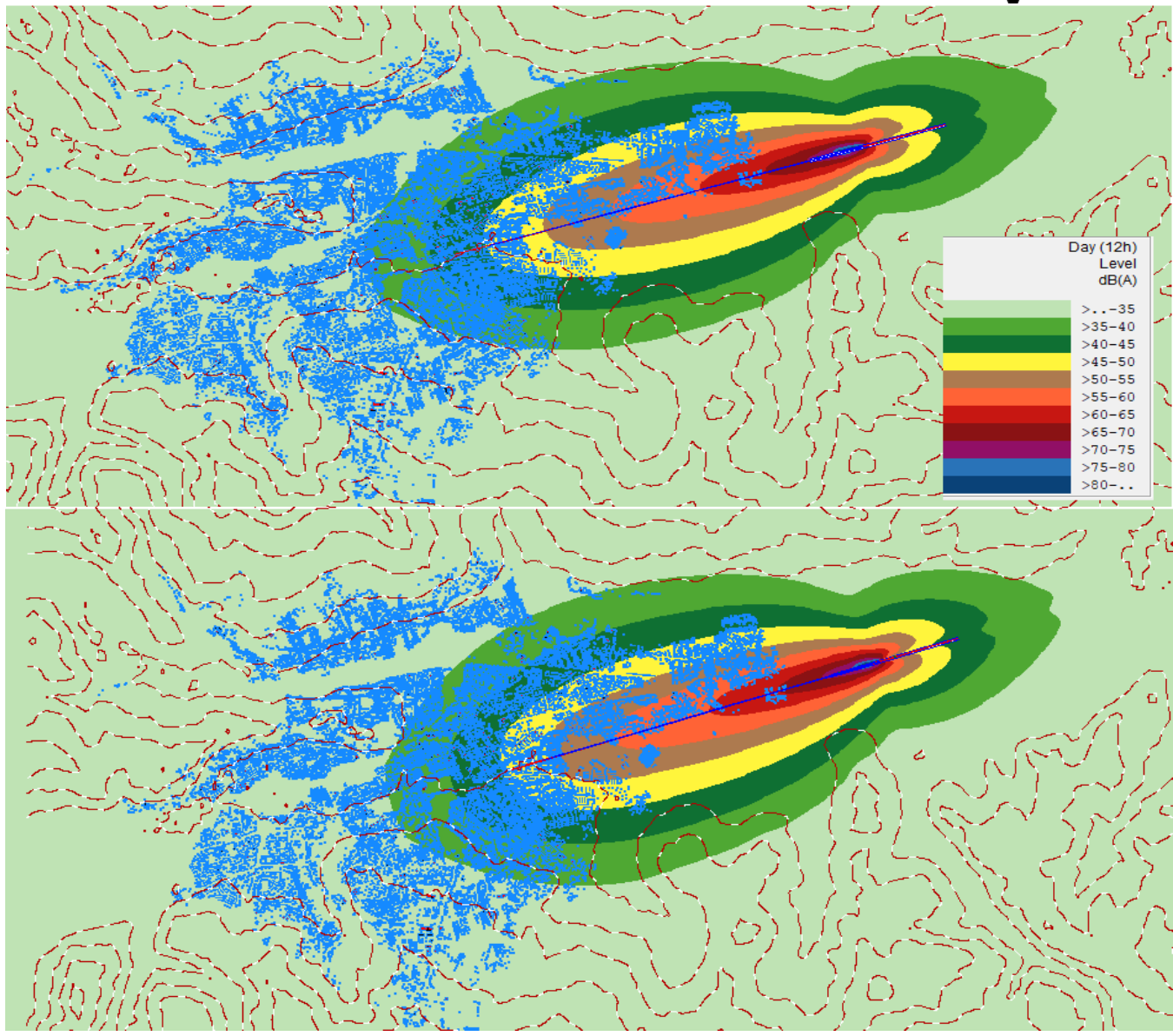
Noise Contours NADP1

- Uniform population distribution (Cluj-Napoca residents) &
- L_{day} noise indicator (12 hrs interval)

Noise exposure NADP2

-five NADP1& NADP2 procedure

There are ***no visible major differences*** in terms of noise contours from the use of one procedure or another.



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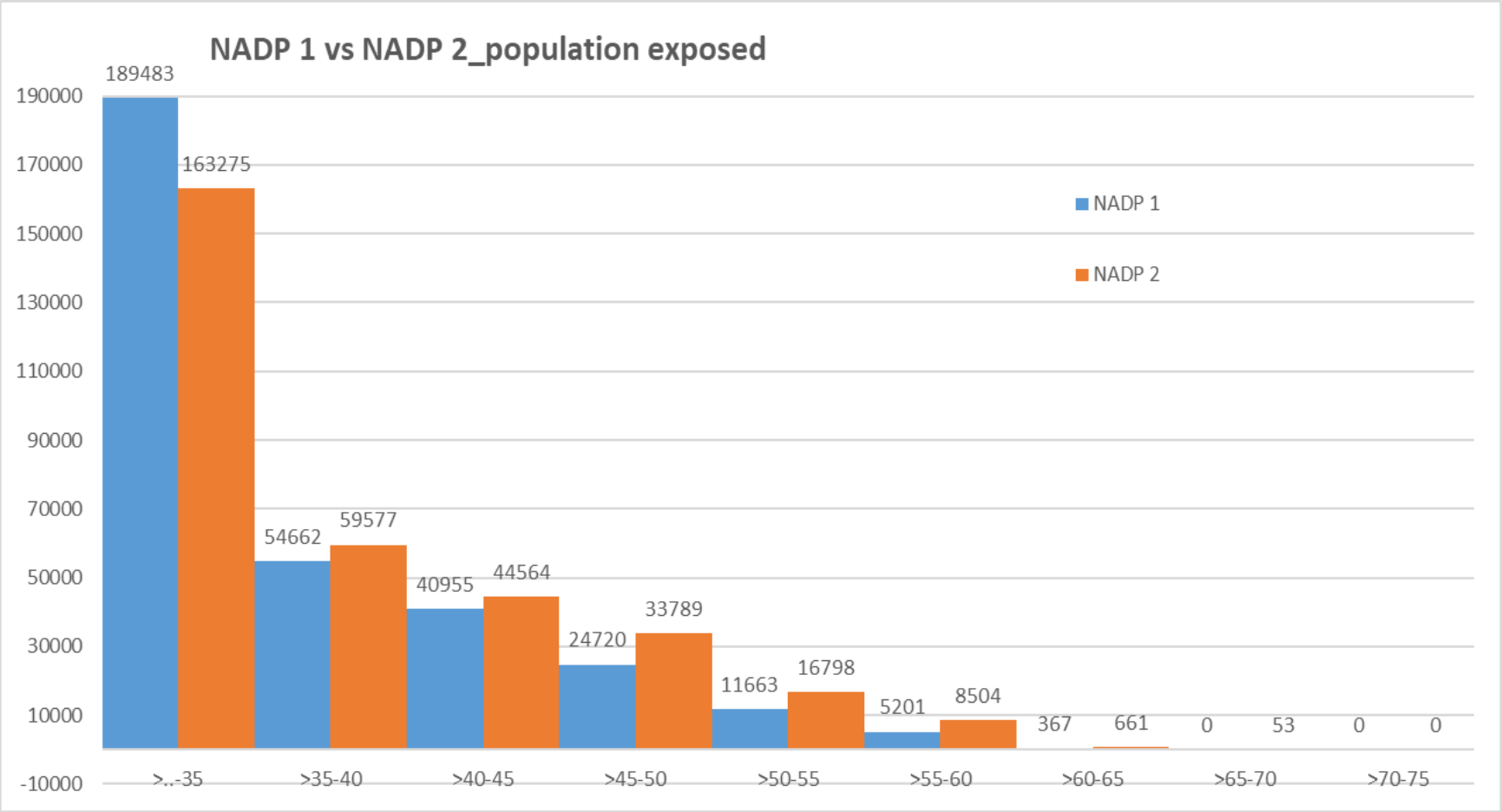
NADP1 vs. NADP2

- For noise contours ≤ 35 dB(A), NADP2 is better than NADP1 (residents farther from the airport)
- For noise contours ≥ 35 dB(A), NADP1 is better than NADP2 (residents close to the airport)



NADP2, which is in orange, exposes more people to higher levels of noise than NADP1

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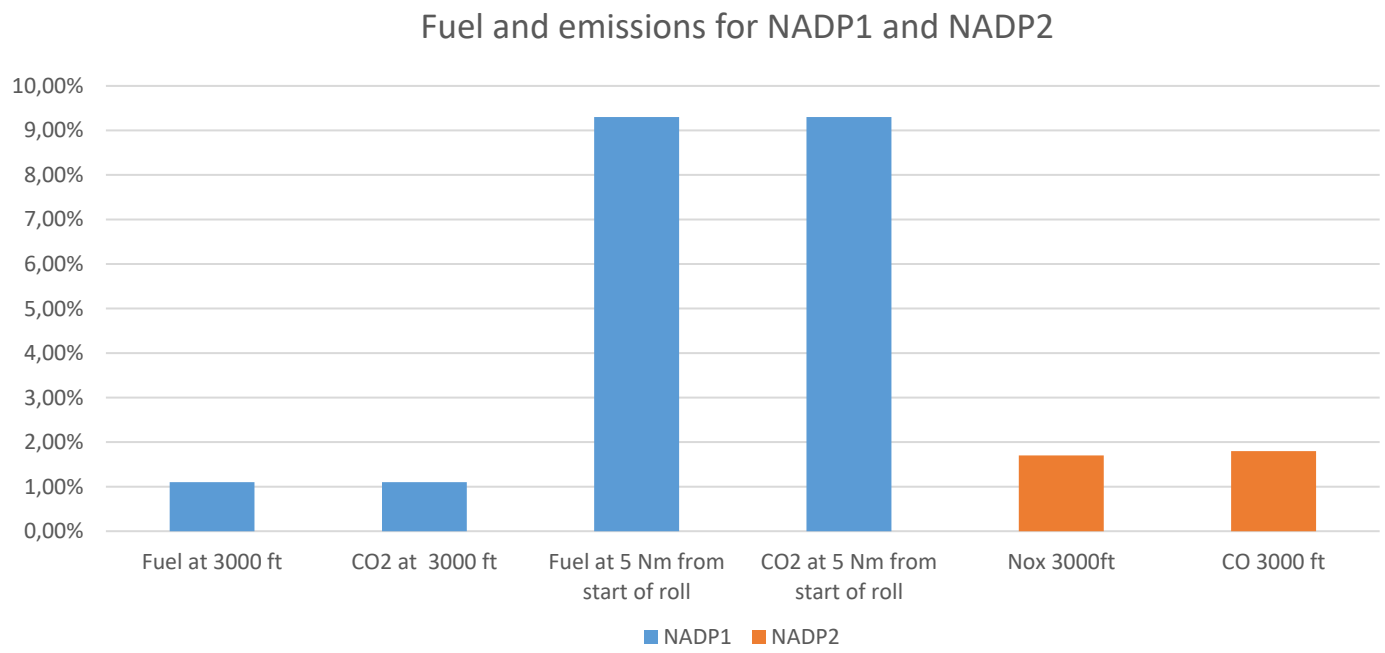
Fuel Consumption - Emissions Comparison

NADP TYPE	Fuel at 3000 ft	CO2 at 3000 ft	Fuel at 5 NM from start of roll	CO2 at 5 NM from start of roll	NOx 3000 ft	CO 3000 ft
NADP1	+1.1 %	+1.1 %	+ 9.3%	+9.3 %		
NADP2					+1.7 %	+ 1.8 %

Analysis has shown that **NOx and CO** atmospheric pollutants have **higher values in the case of NADP2**, therefore the study continued with an understanding of their contribution



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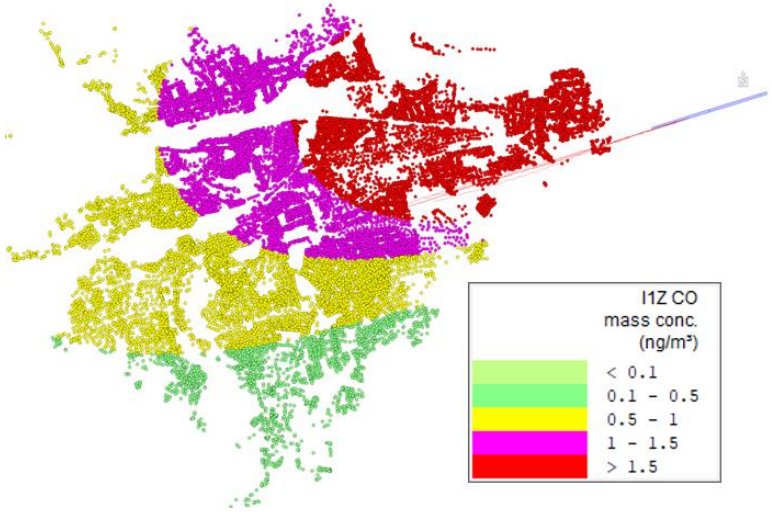
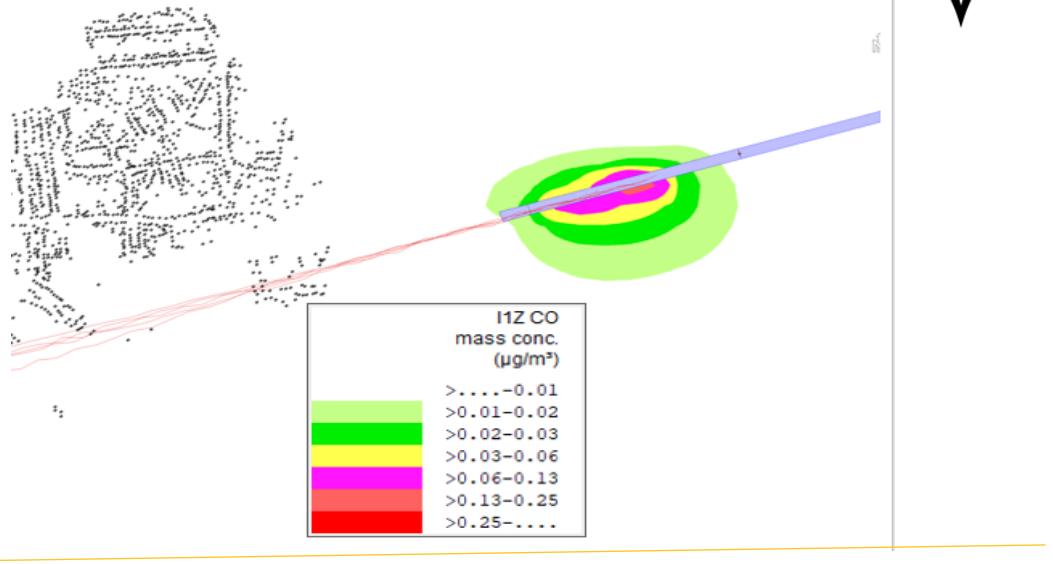
Emission values (CO)

CO emission at the level of residents

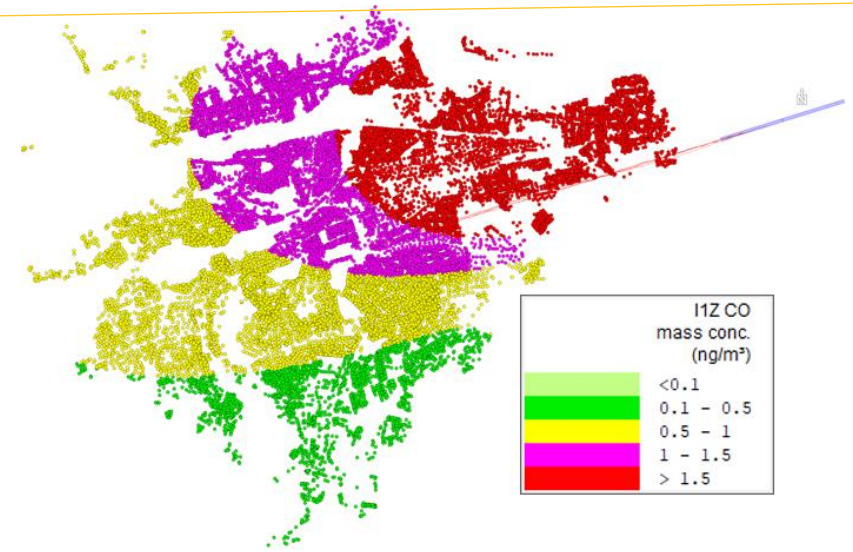
CO dispersion at the level of the Airport

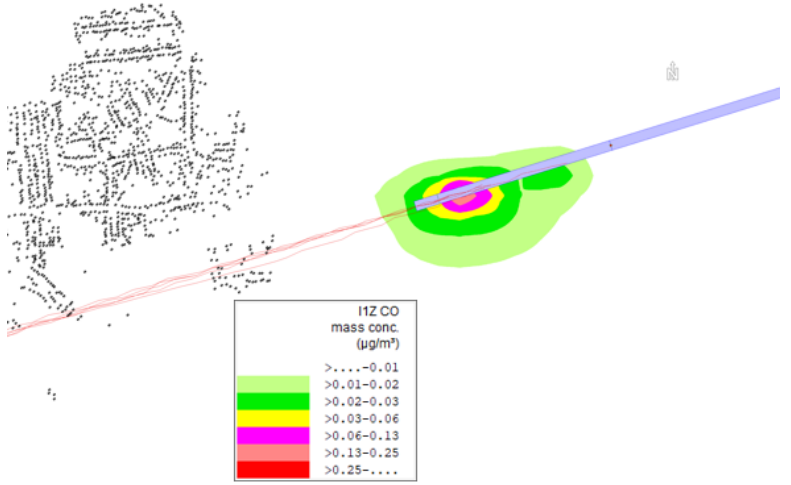
NADP1





NADP2





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Comparison between NADP1 and NADP2 using the number of people exposed to CO

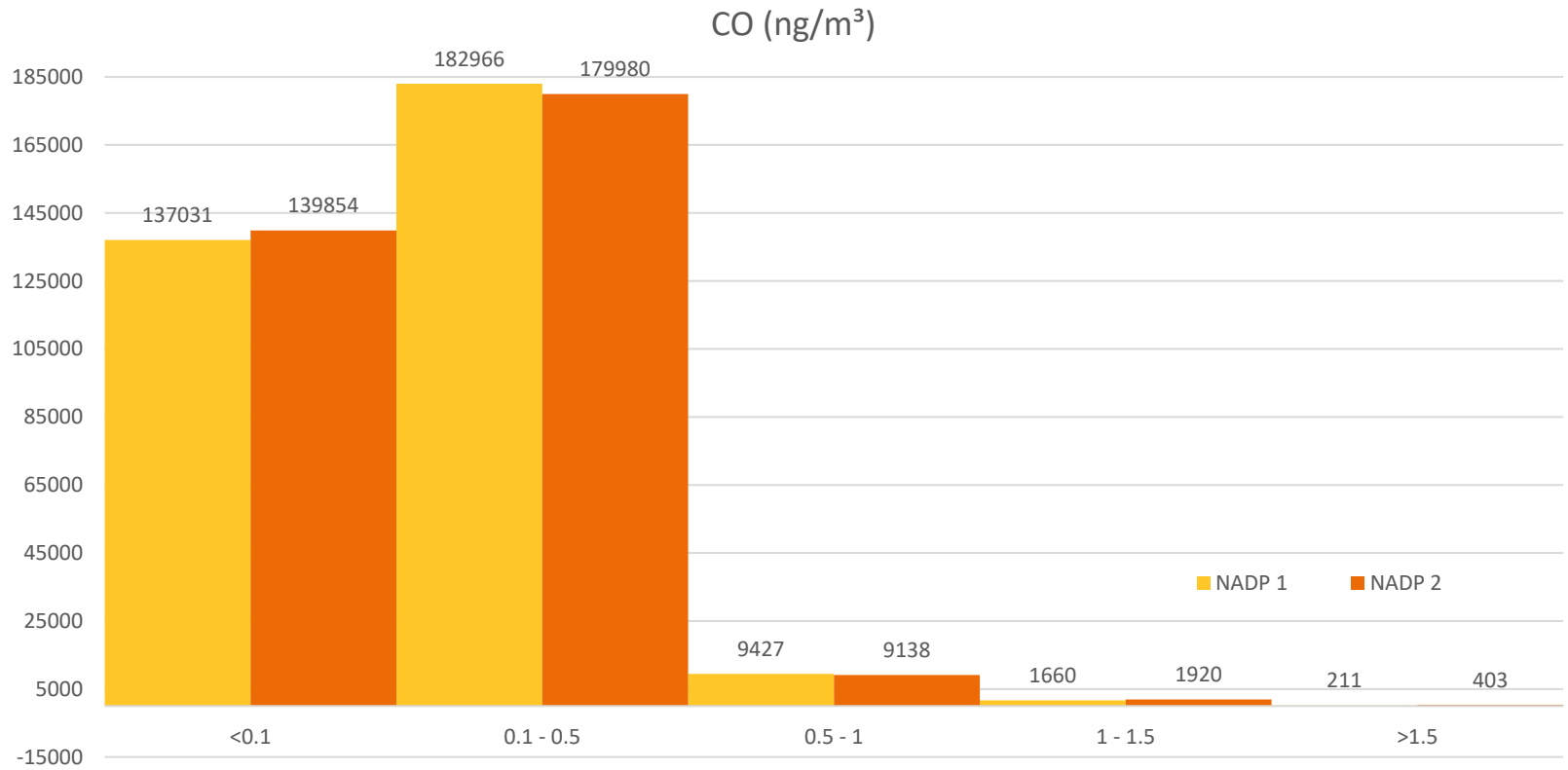
CO (ng/m^3)		<0.1	0.1 - 0.5	0.5 - 1	1 - 1.5	>1.5
Inhabitants	NADP 1	137031	182966	9427	1660	211
	NADP 2	139854	179980	9138	1920	403

NADP1 exposes less people at CO, in the case when particles belong to the <u>following intervals</u>:

- < 0.1 [ng/m^3];
- 1 – 1.5 [ng/m^3];
- > 1.5 [ng/m^3].

NADP2 *exposes less people at CO*, in the case when particles belong to the following intervals :

- 0.1 – 0.5 [ng/m^3];
- 0.5 – 1 [ng/m^3].



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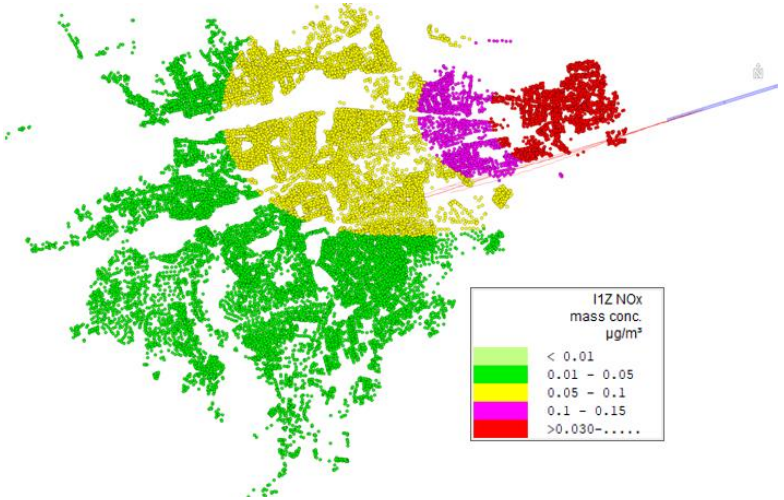
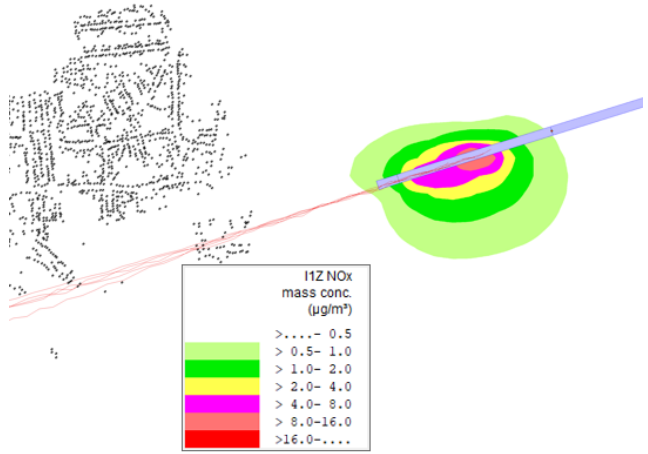
Emissions values (NOx)

NOx emission at the level of residents

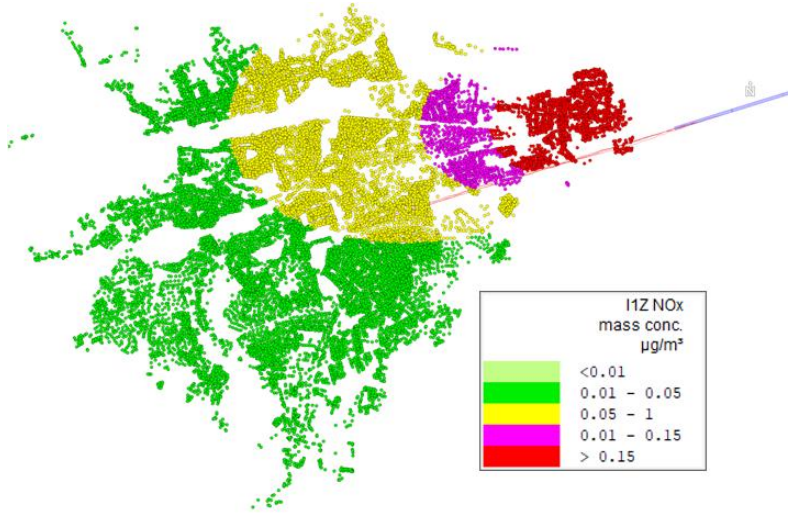
NOx dispersion at the level of the Airport

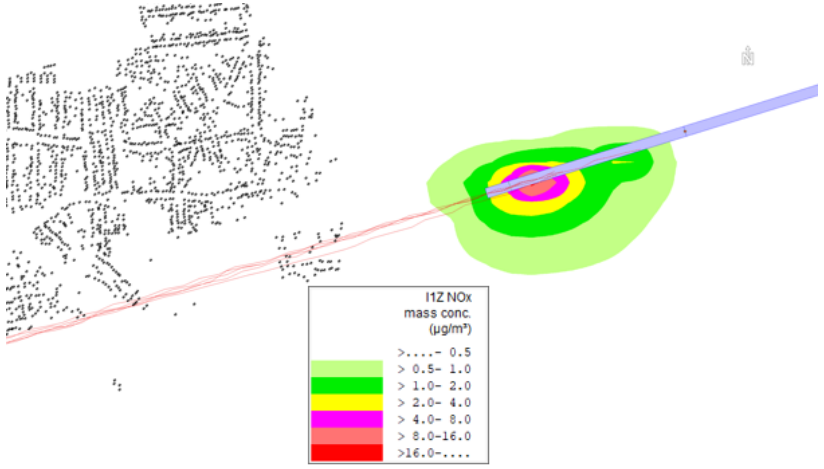
NADP1





NADP2





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Comparison between NADP1 and NADP2 using the number of people exposed to NOx

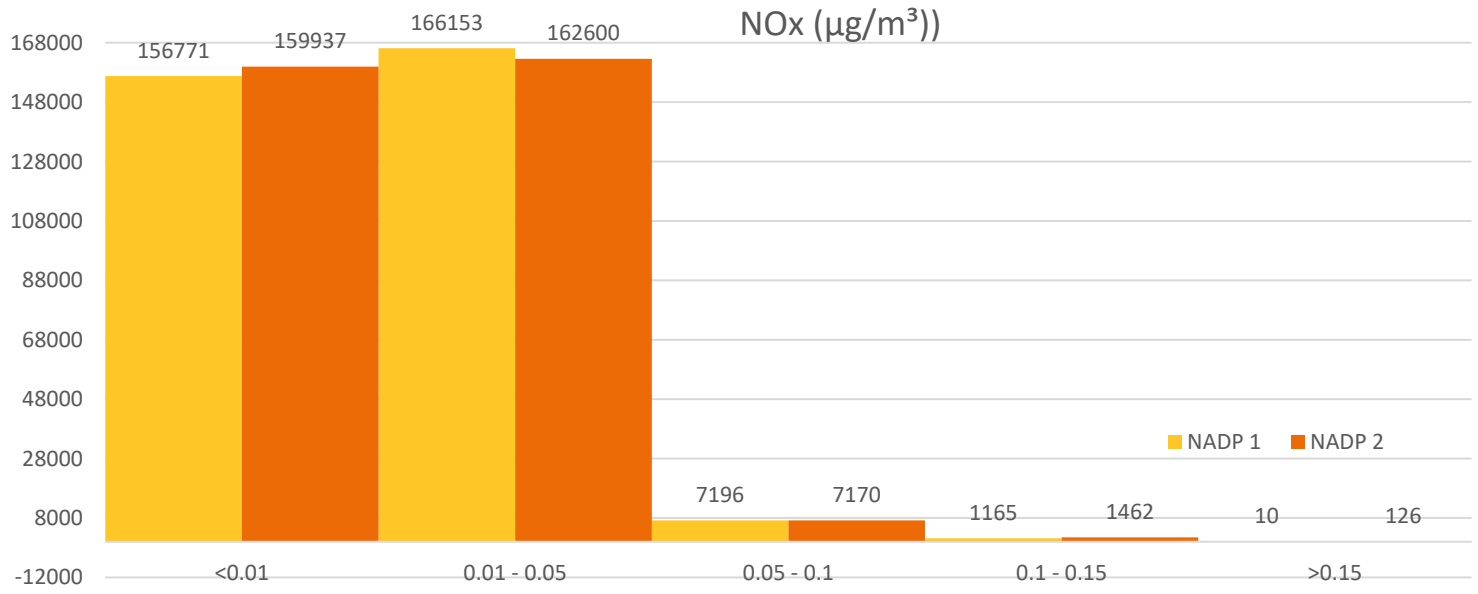
NOx / 1h (µg/m³)		<0.01	0.01 - 0.05	0.05 - 0.1	0.1 - 0.15	>0.15
Inhabitants	NADP 1	156771	166153	7196	1165	10
	NADP 2	159937	162600	7170	1462	126

NADP1 exposes less people at NOx, in the case when particles belong to the following intervals:

- < 0.01 [µg/m³];
- 0.1 – 0.15 [µg/m³];
- > 0.15 [µg/m³].

NADP2 exposes less people at NOx, in the case when particles belong to the following intervals :

- 0.01 – 0.05 [µg/m³];
- 0.05 – 0.1 [µg/m³



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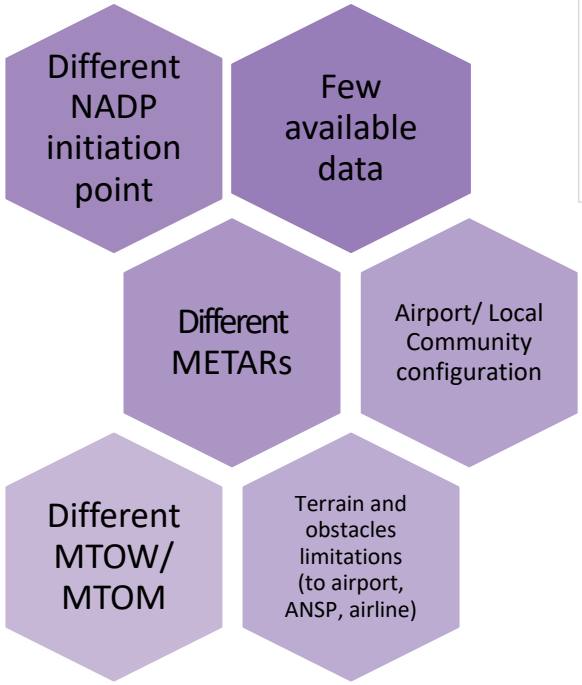
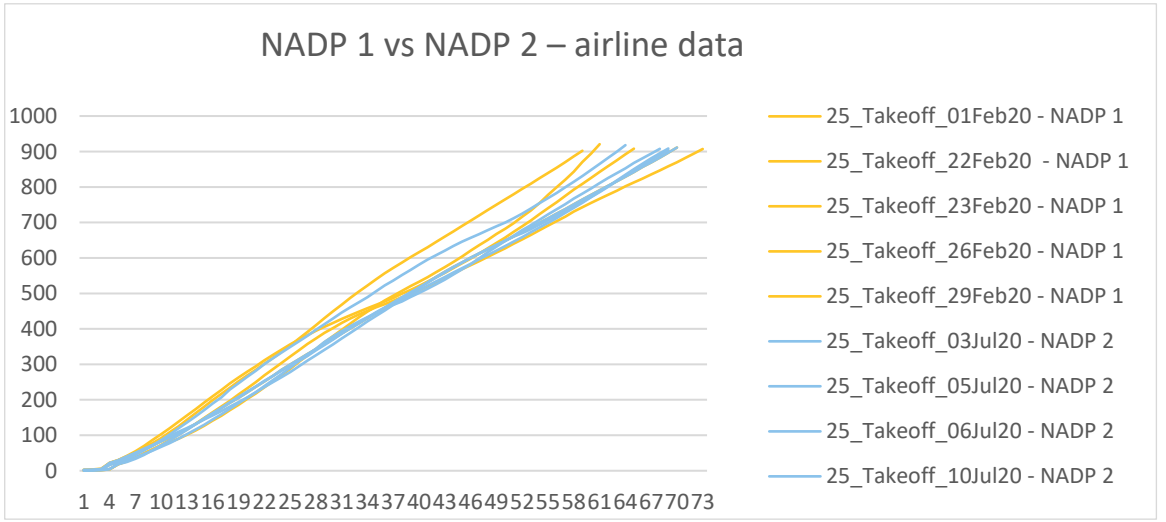
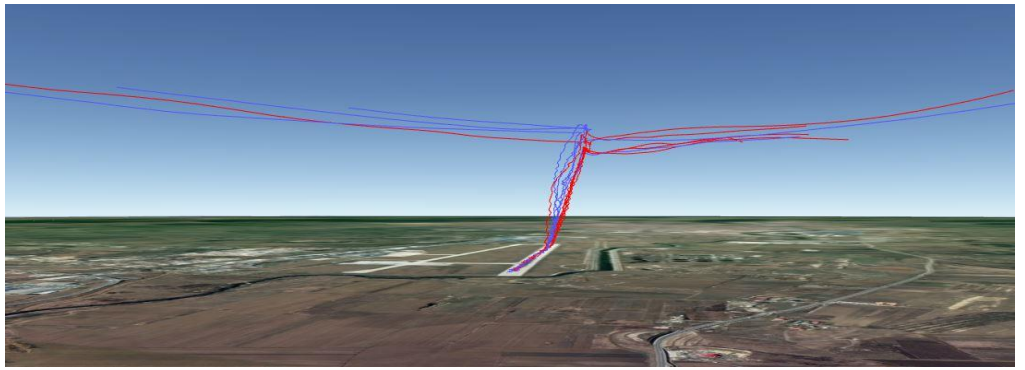
Discussion

NADP1 exposes less people to **higher** levels of noise than NADP2.

In terms of **emissions, NADP2** showed better results than NADP1. However, it is usually difficult to properly determine the differences between emissions from NADP1 and NADP2 (in most cases, there are similar results), more data being necessary in order to draw an adequate







Important observations!

1. NADP1 may imply higher fuel consumption (for the airline);
2. NADP procedures **are relatively new**, therefore more training for pilots and ATCOs is needed.

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Relevant SDGs for Noise & Emissions Interdependencies

Preliminary conclusions: assessment on noise & emissions performed with ***different tools***…

SDGs	Description	Environment	Impact/Relevance
Goal 3	Good health & Wellbeing	noise, emissions/AQ	Health
Goal 4	Quality Education	Both	Knowledge
Goal 7	Affordable & Clean Wnergy	Fuel efficiency/Emissions	Climate change& LAQ/Health
Goal 9	Industry, Innovation and Infrastructure	Operational procedures	Tool, Innovations
Goal 11	Sustainable Cities and Communities	Airport communities	Health & wellbeing
Goal 13	Climate Action	Emissions	Climate Change
Goal 17	Partnership for the Goals	Noise, fuel, emissions	Finding better tools to assess trade-offs; new renewable energy sources; policy making support

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Conclusions & Follow Up

Initial assessment has identified **7 relevant SDGs in UAM deployment** by assessing the current UAM use-cases (*UAM Use-cases*).
Although there was no pre-established hypothesis, this assessment set **high expectations for UAM** with regards to climate action and decarbonisation of transportation.

7 relevant SDGs in assessing noise & emissions interdependencies

Opportunity for joint work:

- building the theory around UAM relevance to SDGs by using stakeholders' expertise.
- assessing the impact of SDGs on aviation noise & emissions interdependencies:
  - noise-carbon emissions;
  - noise impact- air quality impact (health impact)
  - develop proper tools

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Thank you!

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