The Significance of the Sustainable Development Goals in the Aviation sector
-from the airport interdependencies to UAM-

KTH Centrum för Hållbar Luftfart (CSA)

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Content

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

### The most relevant UN Sustainable Development Goals (SDGs)

<table>
<thead>
<tr>
<th>Goal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Industry, Innovation and Infrastructure</td>
<td>Modernize and develop quality, viable, sustainable, and powerful regional and cross-border infrastructure, in order to support economic development and human well-being, with a focus on fair and equitable access by all. Improve road safety.</td>
</tr>
<tr>
<td>11. Sustainable Cities and Communities</td>
<td>Promote a set of local measures for urban areas with a view to developing those functions and equipment able to ensure growth in the competitiveness of cities at European and international level. Improve road safety.</td>
</tr>
<tr>
<td>10. Reduced Inequalities</td>
<td>Bring Romania closer to the EU average for 2030 in terms of the indicators for sustainable development.</td>
</tr>
<tr>
<td>13. Climate Action</td>
<td>Intensify Romania’s efforts to achieve the transition to a “green” economy, characterised by low carbon dioxide emissions and resilience to climate change.</td>
</tr>
</tbody>
</table>
## SDGs - Targets and Indicators

<table>
<thead>
<tr>
<th>Target</th>
<th>Description</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TARGET 3.6</strong></td>
<td>By 2020, halve the number of global deaths and injuries from road traffic accidents</td>
<td><strong>INDICATOR 3.6.1</strong> Death rate due to road traffic injuries</td>
</tr>
<tr>
<td><strong>TARGET 3.9</strong></td>
<td>By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air pollution</td>
<td><strong>INDICATOR 3.9.1</strong> Mortality rate attributed to household and ambient air pollution</td>
</tr>
<tr>
<td><strong>TARGET 7.2</strong></td>
<td>By 2030, increase substantially the share of renewable energy in the global energy mix</td>
<td><strong>INDICATOR 7.2.1</strong> Renewable energy share in the total final energy consumption</td>
</tr>
<tr>
<td><strong>TARGET 8.3</strong></td>
<td>Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation</td>
<td><strong>INDICATOR 8.3.1</strong> Proportion of informal employment in total employment, by sector and sex</td>
</tr>
<tr>
<td><strong>TARGET 9.4</strong></td>
<td>By 2030, upgrade infrastructure and retrofit industries to make them sustainable</td>
<td><strong>INDICATOR 9.4.1</strong> CO₂ emission per unit of value added</td>
</tr>
<tr>
<td><strong>TARGET 9.5</strong></td>
<td>Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries</td>
<td><strong>INDICATOR 9.4.1</strong> Researchers (in full-time equivalent) per million inhabitants</td>
</tr>
<tr>
<td><strong>TARGET 11.6</strong></td>
<td>By 2030, reduce the adverse per capita environmental impact of cities (special attention air quality)</td>
<td><strong>INDICATOR 11.6.2</strong> Annual mean levels of fine PM (e.g. PM₂.₅ and PM₁₀) in cities (population weighted)</td>
</tr>
<tr>
<td><strong>TARGET 11.b</strong></td>
<td>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</td>
<td><strong>INDICATOR 11.b.2</strong> Proportion of local governments that adopt and implement local disaster risk reduction strategies</td>
</tr>
<tr>
<td>Quiet</td>
<td>Clean</td>
<td>Sustainable</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-----------------------------------------------------------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>Aircraft noise (airframe landing gear)</td>
<td>Aircraft design and optimization to reduce fuel burn and CO₂ emissions</td>
<td>Product end-of-life</td>
</tr>
<tr>
<td>Engine (propeller, turbomachinery)</td>
<td>Advanced engine combustor concepts to reduce fuel burn, NOₓ and particulate matter</td>
<td>Green manufacturing and maintenance repair and operations (MRO)</td>
</tr>
<tr>
<td>Community noise</td>
<td>Sustainable aviation fuels (SAF)</td>
<td>Material of concern</td>
</tr>
<tr>
<td>Cabin noise</td>
<td>Optimized navigation and avionics</td>
<td>Recycling</td>
</tr>
</tbody>
</table>
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/](https://aviationbenefits.org/))
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.** 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.
Relevant SDGs for Greening the aviation sector (2)

**TARGETS**

9. **INDUSTRY, INNOVATION AND INFRASTRUCTURE**

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**

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**


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.
Relevant SDGs for Aircraft Noise Reduction

**GOOD HEALTH AND WELL-BEING**

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

**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 cultural diversity and of humanity.

**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.

**PARTNERSHIPS FOR THE GOALS**

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

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.
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...
SDGs Relevance for New Innovative Areas

**AFFORDABLE AND CLEAN ENERGY**

**TARGETS**

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

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

**INDICATORS**

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

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.

**TARGETS**

7.4. — By 2030, substantially increase access to affordable improved cooking solutions.

7.5. — By 2030, significantly improve access to sustainable energy services.

**INDICATORS**

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

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

**INDUSTRY, INNOVATION AND INFRASTRUCTURE**

**TARGETS**

9.1. — Promote inclusive and sustainable industrialization and foster innovation.

9.2. — Build domestic and international capabilities to upgrade globally competitive and sustainable industrial sectors.

9.3. — Increase scientific research and development expenditure as a proportion of GDP.

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 1 million people.
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.
SDGs Relevance for Raising Awareness on the Impact of Air Travel

**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, peace, and justice.

**8.5.** — By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value.

**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.

**13.3.** — Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

**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.

**QUALITY EDUCATION**

**DECENT WORK AND ECONOMIC GROWTH**

**RESPONSIBLE CONSUMPTION AND PRODUCTION**

**CLIMATE ACTION**

**PARTNERSHIPS FOR THE GOALS**
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)
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...
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
Global distribution of UAM Use-cases

Total UAM Use-cases 2019

- Logistics and Goods delivery: 23 cases
- Public Services (First Response): 19 cases
- Air Commute: 15 cases
- Public Services (Non-First Response): 12 cases
- Asset Maintenance: 9 cases
- Healthcare Providers: 8 cases
- Entertainment and Media: 4 cases
- Agriculture: 2 cases
- Scientific Research: 1 case
- Security: 1 case

Dioane, 2020; MSc thesis Cranfield University
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.
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!
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.
## Contribution of existent UAM use-cases to SDGs

<table>
<thead>
<tr>
<th>UN SDG</th>
<th>UAM Use-cases</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3 Good Health and Well-being</strong></td>
<td>Logistics and Goods delivery</td>
</tr>
<tr>
<td><strong>7 Affordable and Clean Energy</strong></td>
<td>Logistics and Goods delivery</td>
</tr>
<tr>
<td><strong>8 Decent Work and Economic Growth</strong></td>
<td>Logistics and Goods delivery</td>
</tr>
<tr>
<td><strong>9 Industry Innovation and Infrastructure</strong></td>
<td>Logistics and Goods delivery</td>
</tr>
<tr>
<td><strong>11 Sustainable Cities and Communities</strong></td>
<td>Logistics and Goods delivery</td>
</tr>
<tr>
<td><strong>13 Climate Action</strong></td>
<td>Logistics and Goods delivery</td>
</tr>
<tr>
<td><strong>17 Partnerships for the goals</strong></td>
<td>Public Services (First Response)</td>
</tr>
</tbody>
</table>
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.
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/](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
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*
Interdependencies in the airport context

- Stakeholders involved...
- Operational procedures

**Findings**

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

**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)

*Used for noise OR emissions

**Used for noise AND emissions

Source: ANIMA, D2.7, 2020
Manchester Metropolitan University

Catania Airport case study

**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
Results (1)

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)
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.
Gaps Identified

Interdependencies are not in focus! Information fragmented. Need to be brought together to inform stakeholders on interdependencies potential.
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*
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
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.
• For noise contours \( \leq 35 \text{ dB(A)} \), NADP2 is better than NADP1 (residents farther from the airport)
• For noise contours \( \geq 35 \text{ dB(A)} \), 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
### Fuel Consumption - Emissions Comparison

<table>
<thead>
<tr>
<th>NADP TYPE</th>
<th>Fuel at 3000 ft</th>
<th>CO2 at 3000 ft</th>
<th>Fuel at 5 NM from start of roll</th>
<th>CO2 at 5 NM from start of roll</th>
<th>NOx 3000 ft</th>
<th>CO 3000 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>NADP1</td>
<td>+1.1%</td>
<td>+1.1%</td>
<td>+9.3%</td>
<td>+9.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NADP2</td>
<td></td>
<td></td>
<td></td>
<td>+1.7%</td>
<td>+1.8%</td>
<td></td>
</tr>
</tbody>
</table>

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.
Manchester Metropolitan University

Emission values (CO)

CO emission at the level of residents

CO dispersion at the level of the Airport

NADP1

NADP2
NADP1 exposes less people at CO, in the case when particles belong to the following intervals:

- < 0.1 [ng/m³];
- 1 – 1.5 [ng/m³];
- > 1.5 [ng/m³].

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

- 0.1 – 0.5 [ng/m³];
- 0.5 – 1 [ng/m³].
Emissions values (NOx)

NOx emission at the level of residents

NADP1

NOx dispersion at the level of the Airport

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

**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]
Manchester Metropolitan University

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 conclusion.

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.
Relevant SDGs for Noise & Emissions Interdependencies

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

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

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