REGULATORY AND ORGANIZATIONAL FRAMEWORK TO ADDRESS AVIATION EMISSIONS

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PREFACE

The International Civil Aviation Organization (ICAO) and its Member States are working together to develop State Action Plans to Reduce CO_2 Emissions from International Aviation. The development and completion of States' Action Plans on CO_2 emissions reduction activities from international aviation requires the establishment of a structured cooperation process amongst national aviation stakeholders which aims to provide the State authority with the information it needs to set-up a long-term strategy for the mitigation of international aviation CO_2 emissions. The voluntary submission of an Action Plan to ICAO provides the opportunity for States to showcase policies and actions, including tailor-made measures that are selected on the basis of their respective national capacities and circumstances.

Many Member States, particularly Developing States and Small Island Developing States (SIDS), continue to investigate the institutional and financial resources necessary to develop and implement their Action Plans, and the actions therein. For example, many States, through their civil aviation authorities, are beginning to integrate environmental programmes into their planning and development, and these need to be coordinated with other government agencies. Some States also endeavour to establish or improve the national regulatory and policy frameworks necessary to encourage low carbon technology deployment, which is critical to stimulating private sector market activity. Others would also like to benefit from low carbon technologies that are being successfully developed in other parts of the world. This means that the State Action Plan initiative can be key to States developing coordinated activities aimed at reducing CO_2 emissions from international civil aviation.

ICAO has developed Doc 9988, *Guidance on the Development of States' Action Plans on CO_2 Emissions Reduction Activities,* which aims to support Member States as they develop and implement their Action Plans. As of November 2017, 105 States representing more than 90.1 per cent of global revenue tonne kilometres (RTK) have voluntarily submitted their Action Plans to ICAO. Doc 9988 presents the basket of measures that Member States can consider for reducing CO_2 emissions from civil aviation. One central consideration is helping Member States assess the organizational capacity of their civil aviation authority to develop and implement Action Plans and related environmental programmes, in cooperation with its aviation stakeholders.

The purpose of this guidance is to inform ICAO Member States on how changes in regulatory policies and organizational frameworks can help them reduce CO_2 emissions from international aviation activities in connection with the implementation of State Action Plans. It includes the possible steps States could take to integrate an environmental unit within their administration to achieve aviation-related environmental objectives. While the focus of ICAO is on international aviation CO_2 reduction activities, adopting policies and procedures appropriate to individual States can also minimize CO_2 from many energy consuming activities at a national level (e.g. at airports), beyond those for international aviation, thus creating environmental co-benefits. Building internal capacity to address climate change will also enable civil aviation authorities to better respond to a range of aviation-related environmental issues, including local air quality and noise.

Together with guidance documents on *Sustainable Aviation Fuels*, *Financing Aviation Emissions Reductions*, and *Renewable Energy for Aviation: Practical Applications to Achieve Carbon Reductions and Cost Savings*, this guidance on regulatory and organizational frameworks will contribute to ICAO's comprehensive approach to support its Member States in the implementation of their Action Plans to address CO_2 emissions from international civil aviation.

LIST OF ACRONYMS AND SYMBOLS

ADB	Asian Development Bank
AfDB	African Development Bank
AL	Arab League
AU	African Union
ANSP	Air Navigation Service Provider
APER	Action Plan on CO_2 Emissions Reductions
APU	Auxiliary Power Unit
ASBU	Aviation System Block Units
ASEAN	Association of Southeast Asian Nations
ATM	Air Traffic Management
ATFM	Air Traffic Flow Management
BLADE	Breakthrough Laminar Flow Aircraft Demonstrator Europe
CAEP	Committee on Aviation Environmental Protection
CAF	Development Bank of Latin America
CARICOM	Caribbean Community
CDO	Continuous Descent Operations
CDM	Clean Development Mechanism
CNS/ATM	Communication, Navigation and Surveillance/Air Transport Management
COP	Conference of the Parties
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CSP	Concentrating Solar Power
EBRD	European Bank for Reconstruction and Development
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EU	European Union
FIR	Flight Information Region
FIT	Feed-in Tariff
GANP	Global Air Navigation Plan
GEF	Global Environment Facility
GFAAF	Global Framework for Aviation Alternative Fuels
GHG	Greenhouse Gas
GPU	Ground Power Unit
GSE	Ground Support Equipment
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IDB	Inter-American Development Bank
IEA	International Energy Agency
IFSET	ICAO Fuel Savings Estimation Tool
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
IsDB	Islamic Development Bank
kW	Kilowatt
kWh	Kilowatt hour
LED	Light Emitting Diode
LEED	Leadership in Energy and Environmental Design
LCOE	Levelised Cost of Electricity
MBM	Market-based Measures
MDB	Multilateral Development Bank
MRV	Monitoring, Reporting and Verification
OAS	Organization of American States
PCA	Pre-Conditioned Air
PKP	Passenger Kilometre Performed
PPA	Power Purchase Agreement
PV	Photovoltaic
RFP	Request for Proposal
SAF	Sustainable Aviation Fuel
SARPs	Standards and Recommended Practices
SDG	Sustainable Development Goals
SIDS	Small Island Developing States
TWh	Terawatt Hour
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UN REDD	United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation
USD	United States Dollar

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BACKGROUND

The 39th Session of the ICAO Assembly, held from 27 September to 7 October 2016, adopted Resolution A39-2: *Consolidated statement of continuing ICAO policies and practices related to environmental protection — Climate change*. Resolution A39-2 reflects the determination of ICAO's Member States to provide continuous leadership to international civil aviation in limiting or reducing its emissions that contribute to global climate change.

The 39th Session of the ICAO Assembly reiterated the global aspirational goals for the international aviation sector of improving fuel efficiency by 2 per cent per annum and keeping the net carbon emissions from 2020 at the same level, as established at the 37th Assembly in 2010, and recognized the work being undertaken to explore a long-term global aspirational goal for international aviation in light of the 2°C and 1.5°C temperature goals of the Paris Agreement. The 39th Assembly also recognized that the aspirational goal of 2 per cent annual fuel efficiency improvement is unlikely to deliver the level of reduction necessary to stabilize and then reduce aviation's absolute emissions contribution to climate change, and that goals of more ambition are needed to deliver a sustainable path for aviation. To achieve international aviation's global aspirational goals, a comprehensive approach, consisting of a basket of measures has been identified, namely:

- *Aircraft-related technology development* – purchase of new aircraft and new equipment to retrofit existing aircraft with more fuel-efficient technology.
- *Alternative fuels* – investments in the development and deployment of sustainable aviation fuels.
- *Improved air traffic management and infrastructure use* – improved use of communication, navigation and surveillance/air transport management (CNS/ATM) to reduce fuel burn.
- *Economic/market-based measures* – researching and building awareness of low cost, market-based measures to reducing emissions such as emission trading, levies, and off-setting.

All of these measures, in addition to contributing to carbon neutral growth, advance the social and economic development associated with the UN Sustainable Development Goals (SDGs).

A central element of Resolution A39-2 is for States to voluntarily prepare and submit Action Plans to ICAO. It also lays out an ambitious work programme for capacity building and assistance to States in the development and implementation of their Action Plans to reduce emissions, which States were initially invited to submit by the 37th Session of the ICAO Assembly in October 2010, and update every three years thereafter. ICAO State Action Plans provide the opportunity for States to showcase policies and actions and are intended to be individualized and reflect the specific national circumstances of each ICAO Member State and the opportunities available to them in implementing measures to mitigate CO_2 emissions from international aviation activities. ICAO has prepared ICAO Doc 9988, *Guidance on the Development of States' Action Plans on CO_2 emissions reduction activities* to describe the process of developing or updating an Action Plan. As of November 2017, 105 Member States, representing 90.1 per cent of global RTK have voluntarily submitted their Action Plan to ICAO.

ICAO Doc 9988 provides guidance on the planning activities that precede the preparation of the Action Plan itself. These include the set-up of a well-coordinated team and the establishment of a thorough project management process. Thus, regulatory organizational aspects become a key success factor for the development of a robust State Action Plan.

This regulatory guidance has been prepared to help ICAO Member States plan and develop strategies and programmes to minimize emissions from international aviation activities. It provides details on why it is important to reduce international aviation emissions, the challenges of doing so, why regulatory and organizational frameworks may be necessary, and the steps States can take to implement the necessary changes.

1.0 EMISSIONS REDUCTIONS ORGANIZATIONAL FRAMEWORK

Pursuant to Assembly Resolution A39-2, *Consolidated statement of continuing ICAO policies and practices related to environmental protection – Climate change,* ICAO Member States are developing and integrating ICAO policies, Standards and Recommended Practices (SARPs) on environmental protection, including on climate change, into their national regulatory frameworks and programmes. Civil aviation authorities play a significant role in ensuring that the relevant technical expertise is available to successfully design and implement programmes that will deliver the expected environmental benefits.

To implement, manage, and maintain environmental initiatives associated with the reduction of international aviation carbon emissions, States may need to develop or adjust existing organizational programmes. This section reviews some of the regulatory frameworks applicable to international aviation and climate change that may be considered by Member States as they develop expertise and establish a structure to coordinate with other jurisdictions to act on international aviation emissions reductions.

1.1 INTERNATIONAL

Given the international scope of aviation and the need to promote comprehensive and consistent safety standards, the regulation of air transport is harmonized on a worldwide basis through ICAO.[1] International flights are also subject to bilateral air service agreements between States. Although ICAO's mandate relates to international civil aviation, most States also take ICAO's SARPs and guidance material into account in regulating their domestic aviation.[2] Similarly, implementation of international emission reduction measures will have a broader benefit to Member States' national environmental objectives, leading to environmental co-benefits.

ICAO has a leadership role in ensuring that international aviation's growth is sustainable and contributes to the UN SDGs. With the technical support of States and the aviation community, ICAO has developed SARPs for international civil aviation. These SARPs are attached as Annexes to the *Convention on International Civil Aviation* (Chicago Convention). ICAO also provides guidance material for States on various aspects of international civil aviation.

1.1.1 EMISSION REDUCTION RESOLUTIONS

In the area of environmental protection, ICAO has established Standards for aircraft noise and aircraft engine emissions (Annex 16 – *Environmental Protection*, Volume I – *Aircraft Noise*, Volume II – *Aircraft Engine Emissions* and Volume III – *Aeroplane CO_2 Emissions*), as well as Standards and procedures for operational measures, such as landing and departure.[3,4] In October 2016, significant milestones in the development of aviation emission commitments were affirmed by the 39th Session of the ICAO Assembly. These included Assembly Resolutions A39-1, *Consolidated statement of continuing ICAO policies and practices related to environmental protection – General provisions, noise and local air quality*[5]; A39-2, *Consolidated statement of continuing ICAO policies and practices related to environmental protection – Climate change*[6], and A39-3, *Consolidated statement of continuing ICAO policies and practices related to environmental protection – Global Market-based Measure (MBM) scheme*[7]. The global aspirational goals for the international aviation sector of improving fuel efficiency by 2 per cent per annum from 2020 and keeping the net carbon emissions from 2020 at the same level were adopted in 2010, and reconfirmed by the ICAO 39th Session of the Assembly.

1.1.2 CAEP

The ICAO Committee on Aviation Environmental Protection (CAEP) is a key contributor to the technical work of the Organization. As a Committee of the ICAO Council, CAEP assists the Council in developing new policies and SARPs related to aircraft noise and emissions, and more generally to aviation environmental impacts. ICAO also relies on CAEP to advise on technical studies to support ICAO policies and programmes. The CAEP brings together more than 600 international experts, from all fields related to aviation and the environment, to examine the effectiveness and reliability of environmental issues being addressed by ICAO and its Member States. Technical issues that CAEP is evaluating include proposed aircraft certification schemes, emissions from aircraft engines, development and deployment of sustainable aviation fuels, operational measures and emissions-related levies. In 2016, CAEP agreed to recommend to the ICAO Council for adoption the first-ever CO_2 emissions certification Standard for aeroplanes which was subsequently adopted by the ICAO Council in March 2017 and is contained in the new Annex 16, Volume III.

1.1.3 ICAO ENVIRONMENT

In the area of environmental protection, ICAO has adopted a set of three goals:

- Limit or reduce the number of people affected by significant aircraft noise;
- Limit or reduce the impact of aviation emissions on local air quality; and
- Limit or reduce the impact of aviation greenhouse gas emissions on the global climate.

In addition to conducting CAEP activities, ICAO also works with other UN bodies in achieving its environmental goals. For example, ICAO is cooperating with the UN Development Programme (UNDP) and the Global Environment Facility (GEF) on the implementation of the assistance project *Transforming the Global Aviation Sector Programme: Emissions Reductions from International Aviation*. The United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC) also represent fora of interest for issues associated with CO_2 emissions reduction activities.

1.2 REGIONAL

Regional organizations have been formed for different purposes, including political cooperation, economic cooperation, and security. They have often developed organically to help focus international programmes to specific segments of the world with shared characteristics and interests. While not all regional organizations are concerned with global emissions, all could represent a potential partner when implementing international programmes developed through the UN. Examples of regional organizations include the African Union (AU), the Arab League (AL), the Association for Southeast Asian Nations (ASEAN), Caribbean Community (CARICOM), the European Union (EU), and the Organization of American States (OAS).

These organizations have been established to provide support on a variety of issues subject to deliberation under the UN and its agencies. Regional organizations provide a forum for the UN's regional and in-State offices to coordinate on such issues. ICAO has regional offices and contacts that participate within this framework to work on issues of interest to international aviation.

Regional cooperation in the area of climate change occurs through coordination with UN programmes and those of other regional organizations that have an interest, including those active in the environment, energy, and community development. Multilateral Development Banks (MDBs) have been established in various regions and serve as an important organizational component to the delivery of public financing for climate change mitigation. Such banks include the African Development Bank (AfDB), the Asian Development Bank (ADB), Development Bank of Latin America (CAF), European Bank for Reconstruction and Development (EBRD), and the Islamic Development Bank (IsDB).

ICAO is also cooperating directly with regional organizations to support Member States. For example, it is working with the EU on *Capacity Building for CO_2 Mitigation from International Aviation*, a project directed to a selected group of 14 States in Africa and the Caribbean. This joint ICAO-EU assistance project is supporting climate change mitigation through the development and implementation of States' Action Plans on CO_2 emissions reduction from international aviation, establishing aviation environmental systems for emissions monitoring at the State level, and evaluating and implementing mitigation measures.

1.3 BILATERAL

Bilateral cooperation in the area of international aviation CO_2 emissions reduction is primarily conducted through development aid programmes. Donor States seek to provide direct development aid that may be used to reduce recipient States' emissions or build new infrastructure that is resilient to climate change. This aid has an obvious benefit to the recipient State in the form of outside public investment. Such cooperation may also be provided in the form of technical assistance to identifying programmes and projects associated with climate change and emissions reductions that could be the focus of future work.

Within the context of the ICAO State Action Plans on CO_2 emissions reductions from international aviation, ICAO has developed the ICAO Buddy Programme. As a part of this programme, ICAO Member States that have already submitted their State Action Plan are invited to provide support to an ICAO Member State that has not yet developed an Action Plan. ICAO has developed a draft agreement of cooperation for use by ICAO Member States who wish to participate in the programme. The Buddy Programme aims to facilitate the development of international cooperation among ICAO Member States.

1.4 NATIONAL

National programmes for aviation CO_2 emissions reductions require direction from the national government which is translated as part of national environmental and energy policy. This policy can then be implemented by the civil aviation authority with developing expertise in aviation environmental issues. The national experts of the civil aviation authority may coordinate with ICAO on the relevant SARPs, and work with government and industry partners to plan for and implement relevant activities. For the development and implementation of the State Action Plans, States needed to nominate a Focal Point responsible for developing the plan and interacting with the relevant stakeholders. The main components of the national organizational structure relevant to State Action Plans on CO_2 emissions reduction activities for international aviation are described in Section 1.4.2.

1.4.1 POLICY

National policy should first be interpreted by the management staff at the civil aviation authority, such that it can be effectively implemented by the Authority. Updates from ICAO would be communicated through the national government's international agency representatives or Focal Point if one has been designated, to the respective national agencies that are affected. These can include transportation, economic development, environment, and energy. Managers from each of these departments would clarify the effects of ICAO and other international agreements executed by the national government on their existing programmes and would receive direction on how national policy, programmes and activities may need to be amended. Civil aviation authority managers would then work with technical staff to develop and communicate those programmes for review by government decision-makers, followed by interest groups and stakeholders.

1.4.2 TECHNICAL

The role of technical staff is to develop programmes and activities to implement national policy communicated by the Ministry of Transportation's managerial staff. For the Civil aviation authority, the technical staff develops expertise in environmental programmes, including aviation emissions reductions.

For the purposes of coordinating with ICAO, the State is invited to nominate an official Focal Point(s) for the development of the Action Plan on CO_2 emissions reduction activities for international aviation. Customarily, the designee will be current staff working in environment, meteorology, operations, statistics, etc. ICAO then communicates directly with that individual to ensure they have the necessary framing, tools, guidance, and assistance that they need to develop the Action Plan. The Focal Point(s) must work with other staff and stakeholders to collect international traffic and related CO_2 emissions data, identify measures that are available for implementation to address those emissions, and prioritize measures best suited for implementation based on the Member State's existing conditions and available resources.

The Focal Point(s) are the key liaison between ICAO and other international partners, and national stakeholders within a State, including airport management, airlines, utilities, environmental organizations, and local officials. Identifying Focal Point(s) who has organizational support is one of the most important steps toward establishing a State Action Plan on CO_2 emissions reduction activities for international aviation and a related aviation emissions reduction programme.

1.4.3 INTERDEPARTMENTAL

International agreements to implement aviation environmental programmes require the involvement of several different agencies within the national government. While the civil aviation authority is the critical lead as directed by the executive, it must also coordinate with and receive support from the other related agencies with an interest. This specifically can include energy, environment, and economic development.

Some aspects of the plan's implementation may require modification to energy policy and related programmes. For example, if the civil aviation authority seeks to implement renewable energy or make energy efficiency improvements at the airport, it may require support from the energy agency in terms of technical assistance or coordination with energy stakeholders. In addition, the environmental agency could be a resource for identifying technical support for programme development. The economic development agency may be aware of funding opportunities or organizations that may be interested in CO_2 emission reduction programmes. Coordinating across agencies will improve the development of aviation CO_2 emissions reduction planning and programme implementation, while also providing a forum for interagency consultation.

There are some specific best practices that can facilitate interdepartmental cooperation on CO_2 emissions reductions that will benefit international aviation. This may include regular coordination with other transportation departments (e.g., public transportation, marine transportation) to identify common policies and measures that can advance national and international CO_2 emissions reduction objectives. Similarly, transportation representatives could engage energy agencies to discuss policy reform that would benefit international aviation, other transportation modes, and the broader energy infrastructure network and its users.

1.4.4 THE NATIONAL ACTION PLAN TEAM

States need to evaluate their regulatory and organizational capacity to assess emissions from international aviation, and to work with a stakeholder team to plan for and implement programmes and measures to minimize future impacts, consistently with ICAO Resolutions. The designated State Action Plan Focal Point would serve as the team leader. However, they require participation and support from other stakeholders in government and the community.

The National Action Plan Team may be comprised of representatives of the civil aviation authority, whose expertise can contribute to the development and implementation of the Action Plan. This expertise could include: operations, for familiarity with international aviation activities; safety, for compatibility of emission measures with existing aviation activities and procedures; statistics, for understanding air traffic patterns; and management, for oversight on how measures may affect aviation more broadly. Participation from representatives of individual airports who are working in these technical fields on a regular basis is valuable to ensure that planning is consistent with current practices and planned initiatives. Officials from the ministry of transportation would be useful with coordinating international aviation emissions reduction measures with other sectors of the national transportation system, as appropriate. At the same level, input from staff involved with national energy policy would facilitate communication related to ICAO Member States' emissions reduction objectives, and opportunities to develop low carbon energy technologies more broadly.

Non-government stakeholders are also important to the development of the Action Plan. In particular, airlines and ground support service companies have critical data for the development of an emissions baseline, and need to be engaged. Energy technology companies who are active in the region may be able to provide technical information on the economics of low carbon options and initiatives that could be useful for increasing private market participation. Environmental and community organizations can bring input on the benefits of emissions reductions and other environmental programmes to the public.

1.5 EMISSIONS REDUCTIONS ORGANIZATIONAL FRAMEWORK OVERVIEW

There are a variety of organizational structures in place to develop and implement environmental programmes and related activities, including those associated with emissions reductions. Some programmes arise from local interest, while others are developed through cooperation among States.

For issues related to international civil aviation CO_2 emissions, as with many topics associated with climate change, States are working together through ICAO to establish international goals and SARPs, which Member States then further develop and implement at the national level. Many ICAO Member States do not have internal capacity to implement activities to achieve the environmental policies and standards established at the international level. Against this background, it is critical for ICAO to provide guidance on how regulatory programmes can be successfully established.

States can work with ICAO to nominate their State Action Plan Focal Point and establish a National Action Plan Team. From this starting point, the Member State can begin to build internal capacity within the civil aviation authority to implement the objectives associated with the reduction in international aviation emissions.

2.0 ENVIRONMENTAL POLICY

Environmental protection is one of ICAO's Strategic Objectives and supports the sustainable development of international aviation. Similarly, environmental policies adopted by ICAO Member States contribute to achieving a sustainable aviation system, which will in turn help deliver socio-economic benefits. ICAO Member States develop State Action Plans as a means to establish an emissions baseline and identify emissions reduction measures to support the long-term environmentally sustainable growth of aviation, consistent with their policy objectives.

2.1 POLICY OBJECTIVES

When developing a State Action Plan on CO_2 emissions reduction activities for international aviation, a State may consider the following the environmental policy objectives: (1) reduce international CO_2 emissions; (2) improve local air quality; and (3) build environmental capacity. In order to achieve these objectives, civil aviation authorities must work with international, national, and local partners and stakeholders to align environmental policy objectives and implement policies that produce environmental benefits.

2.1.1 REDUCE CO_2 EMISSIONS FROM INTERNATIONAL AVIATION

The transportation sector is a significant contributor to worldwide CO_2 emissions, accounting for approximately 14 per cent of greenhouse gas (GHG) emissions.[8] While international aviation is comparatively a small contributor at 1.3 per cent of all anthropogenic emissions,[9] aviation activities are expected to grow, and the sector recognizes the importance of this projected growth being made environmentally sustainable.

CO_2 emissions are produced by aircraft when in flight and while parked at the gate in-between flights. Objectives associated with reducing CO_2 emissions during flight are primarily focused on advancing aircraft technology, improving operational procedures, and developing sustainable aviation fuels as an additive to and potential long-term replacement for existing jet fuels. Aircraft parked at the gate typically power on-board electrical systems and cabin conditioning by running an auxiliary power unit (APU) fired by jet fuel. These CO_2 emissions can be reduced through electrification of aircraft power when on the ground and by developing clean renewable sources of electricity to provide the power. While clean electric gate power can contribute to reducing CO_2 emissions from aircraft operating international flights, it can also de-carbonize domestic aircraft gate operations and thus generate co-benefits.

Clean power generation can also be scaled to not only offset gate power, but other electricity loads in the terminal and at the airport as well. Diesel-powered ground support equipment (GSE), such as tugs and baggage handlers, can also be converted to electric power in a similar manner as the gate retrofit. Energy efficiency audits and upgrades can further reduce the airport's demand for fossil fuel power.

Each ICAO Member State is invited to develop a State Action Plan on CO_2 emissions reduction activities for international aviation, which establishes a CO_2 emissions baseline and identifies emissions reduction measures for future implementation. In developing the Action Plan, Member States can better understand international aviation's share of CO_2 emissions, enhance cooperation among all aviation stakeholders, identify relevant mitigation strategies, streamline policies, enhance stakeholder support, and promote capacity building.

2.1.2 IMPROVE LOCAL AIR QUALITY

Environmental policies to address international aviation CO_2 emissions will have important benefits for mitigating climate change. In addition, the implementation of such policies could also improve the local air quality at and around the airport. This consideration needs to remain a key component of the airport's environmental policy objectives.

ICAO provides guidance and best practices to Member States on issues associated with air quality through Doc 9889, *Airport Air Quality Manual*.[10] Reconfiguring airport flight corridors to reduce aircraft travel distance and time will improve the overall air quality and reduce noise impacts from arriving and departing aircraft. Electrifying aircraft parked at the gate can also reduce aircraft local emissions occurring on-site and, when combined with a clean energy solution, can also eliminate emission sources more broadly, which may otherwise have been supplied by a fossil fuel power plant. Conversion of fossil fuel powered GSE to an electric source will also eliminate on-site emissions and could represent an environmentally sustainable solution when the electric power is supplied by a renewable energy source.

As part of the development and implementation of State Action Plans, many States plan to implement measures that will also improve local air quality. These measures can support the development of a strong relationship with local communities and allow for further traffic growth, while minimizing environmental impacts.

2.1.3 BUILD CAPACITY IN THE AVIATION SECTOR

A key component of a successful aviation environmental policy is the ability to build relevant national capacity. Civil aviation authorities have the primary objective of issuing a set of regulations to allow for the safe, secure and environmentally sustainable growth of the national and international aviation sector. Such regulations apply to all operational stakeholders, aircraft operators, airports and ANSPs. They require multi-disciplinary skills, one of which being in the area of need is in environmental protection.

Capacity building is often necessary to integrate the specific expertise of the aviation industry and the diverse environmental issues that are encountered in international civil aviation. Once an investment has been made to provide this expertise, it can be advanced through training and through broader information transfer. As more civil aviation authorities develop environmental expertise and expand skills in the area of CO_2 emissions reduction, the State, in cooperation with all operational stakeholders will be able to develop and implement CO_2 emissions reduction plans and achieve its environmental goals.

2.2 POLICY OPTIONS

Specific policy options for CO_2 emissions reductions associated with the global aviation sector derive from the ICAO basket of measures. A summary of these measures and how individual Member States can prepare policy to support their implementation is provided below.

2.2.1 TECHNOLOGY AND STANDARDS

Great strides have been made in aircraft fuel efficiency over the past 50 years. The aviation industry seeks to continue to reduce emissions through technological advances into the future. As an example, the Breakthrough Laminar Flow Aircraft Demonstrator for Europe (BLADE) is part of the Clean Sky research programme which is, among other designs, assembling the natural-laminar-flow sections that will replace the A340's outer wing panels as shown in **Figure 2-1**.[11] In support of this effort, ICAO is implementing policy through the preparation of SARPs to ensure that the best available technology is incorporated into new type and in-production aircraft.[12]

FIGURE 2-1
Concept design improvements to the Airbus A340 considered under the Clean Sky Programme
(Source: Clean Sky Joint Undertaking)

A major milestone in aircraft technology policy was reached in March 2017 when the ICAO Council adopted the CO_2 emission certification Standard for aeroplanes, which is applicable to new aeroplane type designs from 2020, and to aeroplane type designs already in-production as of 2023.[13] Specifically, the design Standard will apply to subsonic jet and turboprop aeroplanes that are new type designs from 2020. It will also apply to in-production aeroplanes from 2023 that are modified and meet specific change criteria. A production cut-off will go into effect in 2028, meaning that in-production aeroplanes that do not meet the Standard can no longer be produced beyond 2028 unless the designs are modified to be in compliance.[14]

Once ICAO publishes technology standards, Member States can incorporate approved changes into their Action Plans on CO_2 emissions reduction activities for international aviation and account for future CO_2 emissions reduction benefits based on the existing and forecasted international aircraft activity in their State.

2.2.2 SUSTAINABLE AVIATION FUELS

A transition from conventional aviation fuels to sustainable aviation fuels (SAF) represents a significant opportunity to reduce emissions from the global aviation sector. The focus of the aviation industry is on the development of “drop-in” fuels, i.e. fuels that do not require any changes to aircraft or fuelling infrastructure, however the commercial scale implementation of such a measure still requires a considerable amount of coordination between national governments, aircraft manufacturers, fuel developers, airlines, and others. An illustration of a possible process of growing/collecting and processing feedstock, transporting products, and delivering a fuel for aircraft use is illustrated in **Figure 2-2**. Pursuant to Assembly Resolution A39-2, ICAO has taken a leadership role in facilitating discussions and supporting interim measures. At the second ICAO Conference on Aviation Alternative Fuels (CAAF/2) in October 2017, ICAO Member States agreed on the ICAO Vision on Aviation Alternative Fuels which will help to ensure that a significant proportion of conventional aviation fuels are substituted with SAF by 2050. ICAO Member States recognize that the sustainability of aviation alternative fuels is of essential importance to the efforts of international civil aviation to reduce its CO_2 emissions. In order for an aviation alternative fuel to be considered an SAF by ICAO, the fuel must meet sustainability criteria, which are currently under consideration by ICAO.

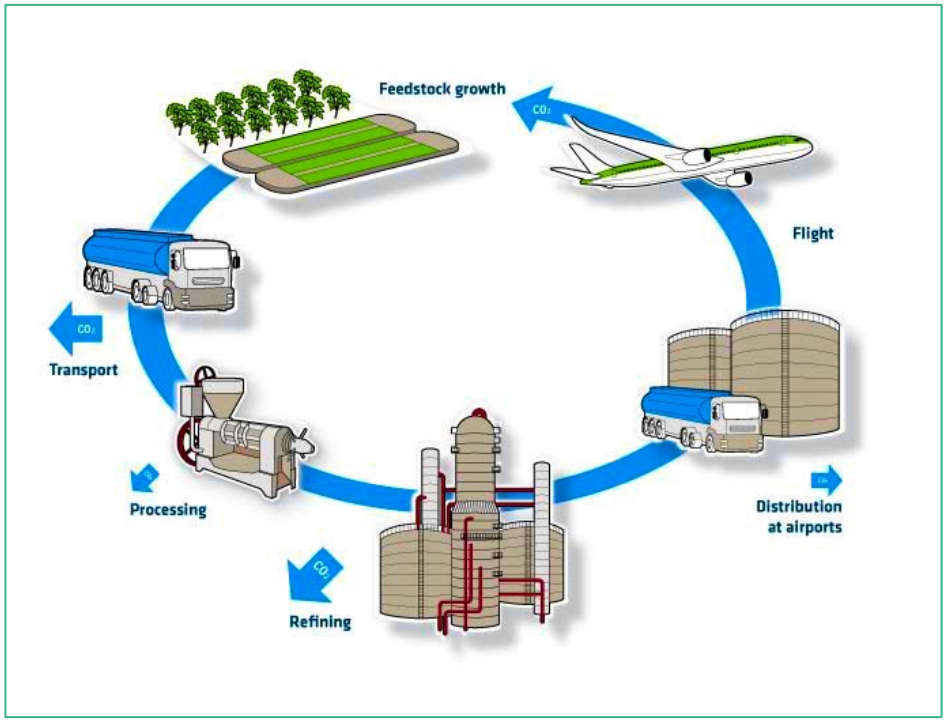

FIGURE 2-2
The development process for growing feedstock and creating SAF (Source: ATAG)

*This figure does not show the life cycle process of SAF derived from municipal waste.

ICAO tracks live alternative fuel flights on its website through the Global Framework for Aviation Alternative Fuels (GFAAF).[15] By November 2017, it reported, *inter alia*, the following commercial flights:

- United Airlines and KLM flights departing from Los Angeles International Airport
- Lufthansa, SAS, and KLM / KLC flights departing from Oslo Airport
- SAS, KLM, and BRA flights departing from Stockholm Arlanda Airport
- All departures from Bergen Airport

At that time, alternative fuels had also been delivered to Stockholm Bromma Airport, Åre Östersund Airport, Göteborg Landvetter Airport, Karlstad Airport, Halmstad Airport, Brisbane Airport, and Chicago O'Hare International Airport. ICAO also reports on the progress being made to advance alternative fuels, including over 100,000 commercial flights using such fuels from a variety of feedstocks, and the announcement of a number of long-term offtake agreements for purchasing alternative fuels.[16] Oslo International Airport, Los Angeles International Airport, Arlanda International Airport, and Bergen Airport have commercial flights refuelling with alternative fuel on a regular basis and have developed as alternative fuel hubs.

ICAO Member States are engaged in the development of SAF to different degrees, with many seeing the potential economic opportunity of using different sources of feedstocks more suitable to their specific circumstances, and developing fuel to serve regional demand. Member States are participating in the development of international guidance and standards on SAF as supplies become available, and will work to implement national policies and programmes with the civil aviation authority and individual airports as programmes progress. ICAO will be publishing additional technical guidance on feasibility studies of sustainable aviation fuels to support Member States with assessing the opportunities.

2.2.3 OPERATIONAL IMPROVEMENTS

More efficient operations on the ground and in the air can reduce aircraft fuel consumption and limit CO_2 emissions from international aviation. Modifications of movements on the ground may be influenced by the need for infrastructure improvements and updating operating procedures. En-route changes seek to limit the distance flown by aircraft to reduce associated fuel burn. **Figure 2-3** shows the concept of continuous descent approach (CDA) as an example of one activity to improve flight route efficiency.

Guidance on operational improvements is detailed in ICAO Doc 10013, *Operational Opportunities to Reduce Fuel Burn and Emissions*.[17] ICAO has also developed guidance on improved operational procedures in the Global Air Navigation Plan (GANP).[18] The GANP presents a series of essential air traffic management (ATM) concepts for implementation on a regional basis to improve efficiency and air transport capacity, while also limiting environmental impacts. The GANP also includes the Aviation System Block Updates (ASBUs) strategy, which focuses on technologies, procedures, and operational concepts available to increase future air traffic capacity, preserve safety, and minimize per passenger environmental impacts. ICAO, through its CAEP, is working with the operational community to assess the potential environmental benefits of the ASBUs.

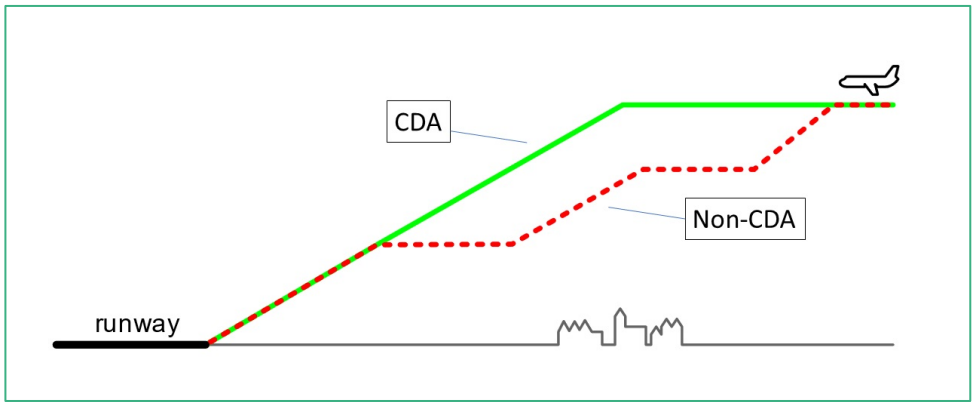

FIGURE 2-3
Continuous Descent Approach and potential benefits (Source: author)

As with aircraft technology and standards, Member States are participating through ICAO, to develop policy to be carried out by States and the industry. As ICAO approves new actions, Member States adopt policies for aircraft operations at airports and look to work with civil aviation authorities to implement operational measures.

Some operational improvements at airports will have a direct benefit to international aviation emissions reductions while others, though still important considerations for the civil aviation authority's overall national environmental programmes, will not.

Specific measures that will contribute to international aviation emission reductions include gate electrification improvements to reduce or eliminate emissions from the APU on international flights, and airfield improvements that make movements of aircraft operating international flights more efficient on the ground. Gate electrification equipment, such as a ground power unit (GPU) frequency converter, represents a significant emission reduction opportunity, which allows aircraft to disengage use of the APU while at the gate and obtain electricity from the terminal. When coupled with a solar power facility, the installation demonstrates the solar at-gate emission reduction Clean Development Mechanism (CDM) small-scale methodology.[19]

In order to keep the aircraft's internal temperature comfortable, this retrofit also requires the installation of an electrically-powered pre-conditioned air unit (PCA). The systems associated with retrofitting the gate for electric power are shown in **Figure 2-4**.

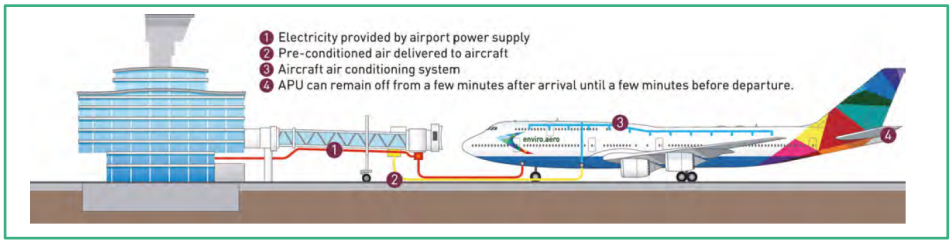

FIGURE 2-4
Gate electrification equipment
(Source: ATAG)

Airfield enhancements that can improve aircraft movements on the ground and reduce CO_2 emissions include the construction of additional taxiways and runways to provide direct terminal access and reduce congestion. Another promising technological improvement known as "electric taxiing" would involve electrically charged equipment to move aircraft, without the use of jet fuel, from the landing point to the terminal gate.

There are a number of other measures that can be taken to reduce or eliminate emissions from GSE and airport off-road vehicle use through conversion to biofuels, electricity or other alternative fuels. While these measures should be important considerations in developing the State's environmental protection goals, these emissions reductions are not covered by ICAO's global aspirational goals for international aviation, as they relate to emissions from domestic sectors. However, these measures deliver environmental co-benefits from ICAO's standpoint.

Civil aviation authorities should consider the emission reduction opportunities associated with infrastructure improvement as part of their long-term airport planning. They may also want to track and support energy legislation that could benefit the airport's use of renewable energy. In addition, there may be opportunities to identify climate financing for such projects and potentially attract private sector investment for certain aspects of the programmes, such as solar power facility development.

2.2.4 MARKET-BASED MEASURES

In 2016, the 39th Session of the ICAO Assembly adopted the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).[20] The scheme follows a phased implementation approach, with a pilot phase from 2021 through 2023; a first phase from 2024 through 2026; and a second phase from 2027 through 2035. All ICAO Member States with airplane operators conducting international flights have to comply with the Monitoring, Reporting and Verification (MRV) requirements of CORSIA. During the pilot phase and the first phase, States can voluntarily decide to participate in the coverage of CORSIA offsetting requirements. For the second phase from 2027, all States that have an individual share of international aviation activities (measured as RTK, in year 2018) higher than 0.5 per cent of total RTK, or whose cumulative share in the list of States from the highest to the lowest amount of RTK reaches 90 per cent of the total RTKs are required to participate in the coverage of CORSIA offsetting requirements. Least Developed Countries (LDCs), Small Island Developing States (SIDS) and Landlocked Developing Countries (LLDCs) are exempted from these offsetting requirements, unless they volunteer.

To ensure the successful implementation of CORSIA by Member States, ICAO has initiated a capacity building and assistance programme, including the convening of regional seminars to share information on CORSIA's design elements and implementation aspects, and to provide States an opportunity to share their existing readiness for CORSIA implementation, with the assessment of further assistance needs. In addition, the ICAO CAEP is working to develop CORSIA-related SARPs and corresponding guidance material, as well as an ICAO tool for the estimation and monitoring of CO_2 emissions under CORSIA, which taken together will establish a robust MRV system for CO_2 emissions from international aviation. The anticipated timeline for the adoption of this proposed SARPs material by the ICAO Council is June 2018, with an applicability date of 1 January 2019. This applicability date of January 2019 will allow States to calculate the CORSIA baseline emissions (based on CO_2 emissions of the international aviation sector in 2019 and 2020), and the offsetting requirements of individual airlines from 2021. ICAO will also determine eligible emissions units, or carbon credits, which airlines will have to purchase in order to meet the offsetting requirements under CORSIA.

Following consultation with States and the adoption of CORSIA-related SARPs by the ICAO Council, integration of the CORSIA-related requirements into Member States' national policy is expected, as part of the development and implementation of their ICAO State Action Plan. More information is available about CORSIA on the ICAO website.[21]

2.3 STAKEHOLDERS

Stakeholders include various parties and actors who have an interest in policy development and implementation. It is important to engage stakeholders early in the process to ensure that their interests are taken into account as policy is developed, so that policies are better understood and successfully implemented. Policy coordination through ICAO is fundamental to identifying and agreeing upon an approach to international aviation CO_2 emissions reductions, which can then be adopted and implemented by individual Member States.

The primary stakeholders associated with the development of environmental policy for international aviation CO_2 emissions reductions include the aviation industry and environmental NGOs. When it comes to the implementation, airport operators and aviation stakeholders have carried out community engagement activities. Stakeholder engagement best practices are provided based on the experience of civil aviation authorities and aviation stakeholders and are included in ICAO Circular 351, *Community Engagement for Aviation Environmental Management*.

2.3.1 AVIATION

The aviation sector includes a broad spectrum of stakeholder groups. There are those related to the industry itself, such as airport operators, airspace users, Air Navigation Service Providers (ANSPs), and manufacturers. In addition, the sector interacts with a wide range of other business and government entities.

- **ANSPs** hold responsibility for managing the airspace over a given geographical area. This includes responsibility for changing and improving air traffic management services and flight procedures for a variety of reasons. These changes can have environmental effects relevant to communities (e.g., change the nature of noise exposure) or more generally (e.g., increase or decrease carbon emissions).

- **Airport operators** provide the infrastructure to operate safe, secure, efficient and environmentally sustainable aircraft operations. They also serve as the connection point between passengers, cargo, and air transportation. Due to their proximity to communities, they are often the primary point of contact for community concerns regarding aviation operations, local transportation-related issues and resource management (noise, water, etc.). Broader public concerns could include issues regarding climate or fuel efficiency. Additional guidance is provided by ICAO in Doc 9184, *Airport Planning Manual,* Part 2 – *Land Use and Environmental Control Management*.[22]

- **Aircraft operators**, or carriers, including airlines, transport goods and people. As a result, they interact most closely with the flying public. However, they may also be affected by local community or broader public concerns. For example, local community noise concerns may restrict the times aircraft operators can arrive or depart at an airport or they may require less fuel-efficient routes (increasing flying time and costs).

- **Aviation service providers** include a variety of businesses developed to support airport operations. As an example, the companies that provide ground support services associated with gate power and aircraft conditioning could be affected if the airport installs new GPU frequency converters and PCA so that the aircraft can obtain power from the terminal. It will be important for the civil aviation authority to consult with ground support companies about such changes and consider existing contractual agreements.

- **Manufacturers** design and build the airframes, engines and other technologies for aircraft. They provide support to other parts of the aviation community and help explain how advanced technology concepts can help reduce environmental impacts. This helps the public better understand the reasons behind the choice of particular pathways, the challenges involved and the trade-offs that have to be made in new designs. They also have a responsibility to address the concerns of their own local communities (e.g., waste, emissions, etc.) as well as community or public concerns in States where their suppliers operate, that may have supply chain impacts (trace metals, etc.).

- **National regulators**, including civil aviation authorities, are responsible for overseeing and regulating the aviation industry. In doing so, they should seek to strike a balance the concerns of all stakeholders, including communities. They may be responsible for establishing and overseeing regulatory standards for noise, emissions, etc., as well as creating the conditions for the growth of the aviation sector.

- **Other national authorities'** activities could have an impact on the aviation sector (e.g., international, national, regional, local). Many States have agencies responsible for regulating environmental issues such as water, clean air, endangered species, or land use. In addition, local governments or municipalities may also have jurisdiction over certain issues and could have a role in community engagement efforts.

- **Passengers** are primarily concerned with safety and efficient transportation. However, passengers are increasingly knowledgeable and concerned with environmental topics. For example, interest in air carriers' GHG emissions has grown in prominence with several carriers and independent organizations enabling passengers to track and offset their carbon footprints.

2.3.2 ENVIRONMENT

Organized groups, such as non-governmental organizations (NGOs) are established to address specific aviation environmental issues, for instance noise. These groups may focus on a specific organization, region, nationally or internationally, responding to where they believe the greatest priority to be. Focus groups might address issues such as wildlife, new airspace flight tracks, or airport growth in general. Some groups may also focus on environmental impacts of relevance to aviation activities but that are not aviation-specific.

2.3.3 COMMUNITY

The community includes a wide array of interests from people who live near the airport, to businesses that benefit from economic activity associated with airport operations. This community can be actively engaged in the planning and implementation of CO_2 emission reduction measures associated with broader outreach regarding airport long-term development programmes.

Community engagement customarily consists of the aviation industry providing information to community groups and individuals on aviation operations and development plans, and communicating the current and future environmental, social and economic benefits and impacts. Public meetings where the community can attend to learn about airport development plans and how long-term planning seeks to maximize economic and environmental benefits, are important to share knowledge and understanding. Community members are often able to provide feedback and express their views by means such as mail, telephone, e-mail, websites and meetings.

2.3.4 ENGAGEMENT BEST PRACTICES

Implementation of community engagement best practices will help States and aviation stakeholders to communicate the importance of aviation improvements and operational objectives. A summary list of best practices is available in ICAO Circular 351. The following method of communications is viewed as being effective:

a) Inform. Information is provided by one party to another;
b) Involve. Information is exchanged between parties; and
c) Collaborate. Information is exchanged and taken into account in decision-making.

Example: Stakeholder Involvement, Republic of Korea

Since 2008, the Republic of Korea has been working to reduce greenhouse gas emissions from aviation. A key component of its success has been engaging key stakeholders in the process of initiating, developing, and implementing an Action Plan on reducing CO_2 emissions from international aviation. Led by the Ministry of Land, Infrastructure and Transport (MOLIT), the Republic of Korea formed the Aviation Climate Change Response Group (ACCRG) in 2008 comprised of airlines, airport corporations, the government, research institutions, and other interested parties. The ACCRG systematized previously scattered efforts to improve fuel efficiency and developed a framework and associated database for reducing greenhouse gases. Moreover, it has provided basic guidelines for the research agencies contracted by the government, and has directly participated in research.

The work of the ACCRG transitioned into an effort to develop a State Action Plan consistent with ICAO guidance. To accomplish this, the Republic of Korea organized a task force comprised of interested parties including airlines, airport operators, the government, and research institutions supported by an analysis team. The task force provides direction and guidance to the analysis team and reviews its results and findings. The members of the task force served to represent the positions of their respective institutions (i.e. stakeholders) and also served as liaisons connecting the analysis team with relevant departments at their respective institutions. The task force meets regularly as a committee as well as in smaller subcommittees to address specific issues associated with the Action Plan.

The representatives and their responsibilities are summarized as follows:

Type	Organization	Assigned Tasks
Government - Ministry of Land, Infrastructure and Transport	Airworthiness Division, Air Traffic Management Division, Airport Safety & Environment Division	• Leading task force • Provision of information on air traffic control, airports & etc.
Airline	Korean Air, Asiana Airlines, Jeju Air, T'way Air	• Provision of information & statistics on operation & fuel use • Review of ideas and plans
Airport Operator	Korea Airports Corporation, Incheon International Airport Corporation	• Provision of plans, statistics on airport • Consultations on ideas plans
Research Institute	The Korea Transport Institute	• Analysis, actual work on developing action plan • Hosting meetings for task force
	Korea Transportation Safety Authority	• Provision of relevant data • Advisory
Industry Association	Korea Civil Aviation Development Association	• Provision & review of relevant statistics

2.4 EXAMPLES OF AVIATION ENVIRONMENTAL POLICY

Examples of projects that demonstrate the implementation of environmental policies to reduce aviation emissions are provided below.

2.4.1 TRINIDAD AND TOBAGO AND ATFM

In 2015, the Trinidad and Tobago Civil Aviation Authority introduced the Air Traffic Flow Management (ATFM) concept for the Piarco International Airport Flight Information Region (FIR). The ATFM is a policy to improve the efficiency of the surrounding airspace. It is an important measure in the short- to mid-term due given that the adjacent FIRs, San Juan FIR (Puerto Rico), Maiquetia FIR (Venezuela) and Brazil, are oceanic airspace with high levels of air traffic flow that is expected to grow. The ATFM is a key instrument to improve collaborative decision-making and will support the reduction of fuel consumption caused by delays and other related conditions such as weather, airport capability, and other factors that limit the efficiency of the airspace.[23]

2.4.2 OSLO AIRPORT AND SUSTAINABLE AVIATION FUELS

In January 2016, Oslo Airport started a regular supply of an alternative fuel blend through its existing common fuel distribution system. This was the first time an airport made alternative fuel available to all refuelling aircraft, relying on existing infrastructure. Oslo Airport is operated by Avinor, a State-owned limited company under the Norwegian Ministry of Transport and Communications, which is responsible for 46 State-owned airports. Avinor's goal is to reduce the total GHG emissions associated with its airports regardless of traffic growth, and be a driving force in reducing overall GHG emissions from Norwegian aviation. The successful launch of the alternative fuel project was enabled by government action to initiate its integration into existing jet fuel supply chains.

2.4.3 AIR TRAFFIC MANAGEMENT CASE STUDIES FROM CAEP

CAEP has solicited information on case studies for environmental assessments associated with ATM programmes to improve air transport efficiency and minimize fuel burn. These lessons learned, along with ICAO Doc 10013, *Operational Opportunities to Reduce Fuel Burn and Emissions*, can provide guidance on existing environmental assessments and methodologies to improve environmental assessment processes associated with ATM. Ten case studies have been reviewed by CAEP and are posted on ICAO's website.[24] The case studies come from the following sources:

- Australia: Canberra Airport ITAR (Implementation of Terminal Area RNP - AR)
- CAEP WG2 Task Group Aviation System Block Upgrade (ASBU) Analysis
- France: ILS Interception Altitude Increase in Paris area
- France: new GNSS procedure QFU 30 at Nevers Airport
- Germany: FRAMaK case study
- Italy: Italian Airspace Reorganization
- NATS - London Airspace Management Project (LAMP)
- Sweden: SESAR AIREII:VINGA Validation and implementation of next generation airspace
- United Kingdom: SESAR Operational Focus Area: Full implementation of P-RNAV in TMA
- US FAA NextGen Greener Skies over Seattle

Common themes across these assessments are that the change in routes to improve efficiency may have a cumulative environmental benefit by reducing fuel burn and the number of people exposed to aircraft traffic and associated impacts. However, the communities exposed to new impacts are likely to be most vocal with regards to the negative impacts of the changes. An important lesson learned is to ensure that all communities are informed of the changes such that a comprehensive and diverse public comment can be provided.

2.5 ENVIRONMENTAL POLICY OVERVIEW

ICAO has worked with its Member States to identify the environmental impacts of international aviation activities and has provided SARPs and guidance. ICAO Member States are working to reduce CO_2 emissions from international aviation to allow for sustainable aviation growth and mitigate impacts associated with climate change, to reduce local air quality impacts, and build the capacity of the aviation sector to adequately respond to environmental impacts of international aviation activities.

ICAO Member States have identified a series of policy options that individual States can consider when developing and implementing their State Action Plans on CO_2 emissions reduction activities for international aviation. These include technology and standards, sustainable aviation fuels, operational improvements, and market-based measures. Civil aviation authorities need to work with a diverse group of stakeholders and get their involvement for the effective implementation of these measures. There are a number of examples where States have implemented such measures successfully.

Member States should review these environmental policy measures when developing their State Action Plans, and together with their National Action Plan Team, identify those measures, which are best suited for their individual circumstances.

3.0 ENERGY POLICY

While environmental policies developed in support for the implementation of States' Action Plans on CO_2 emissions reduction activities for international aviation focus on the activities associated with air transport that contribute to international aviation CO_2 emissions, energy policies reach beyond aviation. Civil aviation authorities recognize the importance of energy, its impact on airport facilities and its potential for CO_2 emissions reductions. Energy is one sector where private investment has been effectively mobilized to mitigate climate change, in part due to energy policies and incentives enacted to encourage market development and increase competition. Where advanced energy markets have been developed, aviation organizations can participate to decrease energy costs and reduce CO_2 emissions. This section reviews energy policies being enacted by Member States to create energy markets and the possible role of civil aviation authorities.

3.1 POLICY OBJECTIVES

Energy policy objectives are to modify the existing energy markets and provide consumers with more choice in energy supply. Options seek to preserve and improve the reliability of energy supply, while also increasing competition and providing a diversity of energy products. Green energy plays a central role in energy policy development as it provides long-term cost-benefits based on a life-cycle analysis, primarily as a result of the absence of fuel use through the operational life of the facility. It also values environmental attributes, which may be sought by consumers and are important to national policy interests.

3.1.1 DECREASE EMISSIONS

There are many unique attributes of green energy that provide benefits to energy delivery and consumption. The most obvious is its lack of emissions and contribution to environmental and, specifically, CO_2 emissions reduction goals. For this reason, governments have enacted policies that remove barriers to clean energy generation sources and create demand for renewable energy, as illustrated below. These policies have helped to create markets and trigger competition amongst suppliers, including the scaling-up of production and a decrease in equipment costs. This activity has resulted in attracting private sector investors to increase economic opportunity and reduce CO_2 emissions.

3.1.2 DECREASE ENERGY COSTS AND VARIABILITY

Traditional energy generation is produced from central power plants using fossil fuels such as coal, oil, and natural gas. The price paid by consumers fluctuates with the price of the fuel source. During times of fuel scarcity, prices increase, and consumers must adjust their budgets to accommodate the higher prices. When there is a surplus of fuel, prices fall, and energy is inexpensive. As fossil fuels are a finite resource, there is a long-term expectation that fuel supplies will be depleted and prices will increase.

Incentivizing the development of renewable energy generation facilities decreases the demand on fossil fuels, thereby extending the available fuel supply. Furthermore, because the fuel for renewable energy sources is free, the costs of the energy generated are set by the installation costs averaged across the expected life of the facility, providing a relatively stable and predictable cost. **Figure 3-1** illustrates the cost of energy produced by a renewable energy facility, rising only with inflation, compared with actual prices for natural gas paid in the U.S. market. While there is a risk that energy costs could be at times higher than market rate fossil fuel generated power, long-term prices are stable and are not subject to long-term price increases associated with a limited supply. Therefore, energy policies that incentivize renewable energy increases energy diversity and limits the risk associated with long-term price increases and short-term price variability.

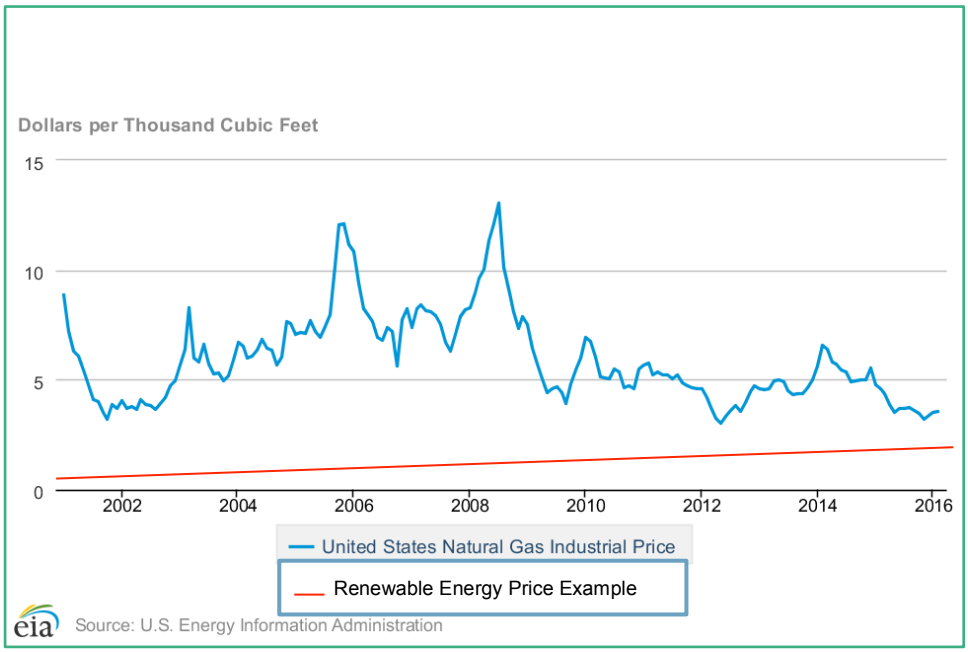

FIGURE 3-1
Example comparing fossil fuel power price volatility with renewable energy (Source: U.S. Energy Information Administration)

3.1.3 DIVERSIFY ENERGY SUPPLY

The majority of the world's energy comes in the form of fossil fuels. Sources for electricity, and heating and cooling, are generated by burning coal, oil, natural gas, propane, and wood. A fundamental challenge with fossil fuel generated energy is that the fuel is often procured from foreign sources and the availability of that supply cannot be controlled. With such uncertainty, the price of the fuel can rise and fall with available supply, or the supply could be shut down. While many larger States may have some domestic fossil fuel supplies to buffer variations in foreign procured supply, renewable energy offers all States an opportunity to diversify supply and protect against supply and price fluctuations. In this context, renewable energy programmes can be seen as a matter of national security.

The global renewable energy industry has grown significantly in recent years. According to the International Renewable Energy Agency (IRENA), renewable energy capacity in MWs installed has more than doubled in ten years (2007-2016).[25] Wind and solar power technologies have increased in efficiency and decreased in costs as unit production has been scaled up. In its 2016 Medium-Term Report on Renewable Energy, the International Energy Agency (IEA) stated that renewable power accounted for more than half of the world's additional electricity capacity in 2015 as the result of supportive government policies and sharp cost reductions.[26] Hydroelectric power is the primary alternative to fossil fuels, available in parts of the world with sufficient resources. Renewable energy is being adopted by governments and private industry, which can benefit from the long-term cost savings of a fuel-free technology and the environmental improvements sought by society.

3.2 INCENTIVES TO ENCOURAGE ENERGY ALTERNATIVES

There are a number of policy mechanisms that have been successful in achieving the energy policy objective described above. Examples of policies adopted in many States are provided below.

3.2.1 DEREGULATION

Deregulation is a broad initiative, which seeks to decrease centralized control of goods and services and increase participation by the private sector and market competition. In the energy sector, utility companies traditionally own both the power generation facilities and the transmission infrastructure, and charge end users for energy consumed accounting for the cost of generation, infrastructure maintenance, and forecasted system enhancements to address future supply demands. A significant benefit for this centralized model is that a single entity is responsible for ensuring that the energy supply is reliable, safe, and adequately priced. A challenge of the centralized mode is that the utility earns revenue for each unit of energy produced, providing it with no incentive to conserve energy or keep prices down. However, government regulation and oversight are typically required to act as a check on the utility.

Deregulation of the energy sector has been implemented over the past two decades with an interest in attracting new actors to energy markets and creating a less centralized energy infrastructure system. Opening up the energy generation market also has allowed energy policy makers to create opportunities for renewable energy generators to supply new products to the market.

Furthermore, involving the private sector in how best to advance the generation and delivery system has allowed new innovations in energy planning. One innovation is building smaller generation units to provide local power close to the demand, known as micro-grids, as opposed to expanding transmission capacity from the centralized power plants. Another is paying consumers to avoid energy use during peak periods rather than building more power capacity. Deregulation seeks to break down the traditional model for electricity, where a single entity owns and manages both power generation and power distribution infrastructure, and allows for increased competition and a greater diversity of energy sources. This concept is illustrated in **Figure 3-2**.

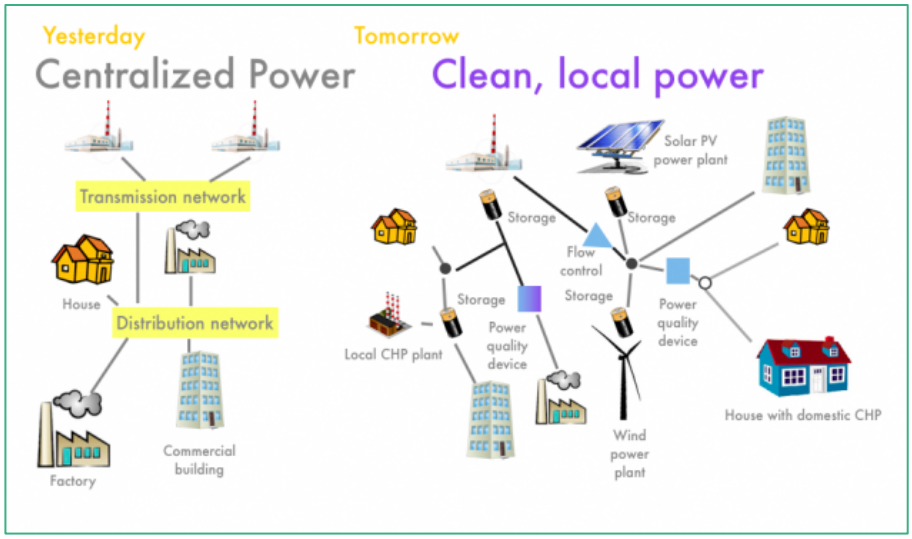

FIGURE 3-2
Comparing centralized power prior to deregulation with decentralized power (Source: Institute for Local Self-Reliance)

3.2.2 ENERGY STANDARDS

Energy standards are set by governments to establish consistent conditions for all energy market participants (generators, consumers, transmitters) to respond to. Standards can be established to promote energy efficiency through code requirements for new construction. They can also be set for the procurement of renewable energy and sustainable biofuels to create a market demand.

Energy efficiency standards are typically directed to improving energy conservation through new construction. Requiring upgrades for existing systems could also provide for energy conservation, but are typically mandated to protect public safety (e.g., limit the potential for a fire). Financial incentives such as rebates and grants are typically the policy employed to address existing energy efficiency opportunities. As an example, funding may be made available to consumers (commercial and residential) to replace inefficient energy systems and appliances. In contrast, standards for new constructions require the use of systems that meet a higher standard to improve energy efficiency. The phase-out of incandescent light bulbs requiring consumers to purchase more efficient light emitting diodes (LEDs) or halogen bulbs in some States is one such programme. Standards are also established for energy systems to encourage their use as part of a recognized sustainable development programme. For example, the U.S. Green Building Council's Leadership in Energy and Environmental Development (LEED) requires projects/buildings seeking to receive LEED Certification to install energy efficient systems that meet specific standards.[27]

Renewable energy standards may be set which mandate the government or the electric utility to purchase a set percentage of power used or distributed in a calendar year, in the form of renewable energy. The percentage is typically increased on an annual basis, sustaining the demand for renewable energy over several years. If the renewable power is not secured as required, the government or utility pays a penalty that is costlier than the price of renewable energy. This type of programme creates a demand for renewable energy that creates a market for the renewable energy industry. To secure the renewable energy, the government or utility may build their own facilities, purchase renewable energy credits, or acquire the renewable energy through a long-term contract. A long-term contract secures a contractual commitment and future revenue stream to support long-term financing.[28]

Policy standards like those describe above can be very effective. Government is a significant consumer of products. Its purchasing power can be directed to buy certain types of products to advance public policy goals. In doing so, the government purchase, assuming it is of a relatively large capacity, can have a positive effect on project economics. Examples of this are provided in the renewable energy and sustainable biofuels markets.

3.2.3 FEED-IN TARIFFS

Feed-in Tariffs (or FITs) are electricity acquisition policies that establish a price to be paid by the electric utility for new power generation, based on the actual cost to develop the technology.[29] Typically, there will be different prices (i.e. cost per kilowatt hour) of electricity delivered by the project for different technology types. For example, it is generally more expensive to generate a kilowatt of solar electricity compared to a kilowatt of wind, so higher prices will be paid for solar power. The advantage of the FIT is that the renewable energy project developer will obtain a signed contract in advance from the grid operator identifying the price that will be paid for the power, which the developer can use to secure financing for the project. The downside of FITs is that the grid operator must put a limit on the total capacity that can be procured, which can result in boom and bust development cycles.

3.2.4 TAX INCENTIVES

Tax incentives are an alternative to the FIT. The intent of the tax incentive is to provide private investors with an opportunity to limit their tax payment by investing in a renewable energy project. As private entities must pay taxes on profits made, policy can be established to reduce tax liability when investments are made on environmentally beneficial projects. The end result is that project developers can convert the tax benefit into cash and use it to produce the renewable electricity at a lower rate. Whereas the FIT sets the price and guarantees a level of profit, the tax incentive gives all developers the same tax incentive and encourages them to find a customer willing to pay the power price for the electricity. Potential customers include the grid operator, public agencies like government or public universities, or private companies who wish to own renewable energy. Tax incentives may be packaged with other programmes, which require grid operators to purchase renewable energy to drive the market demand for green energy.

3.2.5 GRANTS AND LOANS

Member States may enact a surcharge on energy purchases with the fees being directed to a fund to promote energy policies. Such funds have been established for energy efficiency and renewable energy programmes. Often managed by a government or quasi-government institution, the fund managers will advertise programmes to study new technologies or decrease upfront costs for investing in existing technologies. Energy efficiency programmes are typically coordinated with utilities that have expertise in energy efficiency measures. Funds for energy conservation are directed toward existing buildings to buy down the cost of more energy efficient heating and cooling systems, or for insulation to improve retention of heat and cool air in buildings.

For renewable energy, grants are often used to pay for early stage, potentially risky investments, that can demonstrate the efficacy of a project. Loans may be structured such that they convert to a grant if the subject project is not successfully developed or paid with interest if it is successfully developed. If a project receives funding with a successful outcome at the feasibility stage, it may be able to access other energy incentives, such as the FIT or tax incentives, to complete development.

3.3 TOOLS TO IMPLEMENT ENERGY POLICY

Tools are legal mechanisms that can be used, often with support from laws and policies, to structure low carbon emission programmes that increase private sector participation. Three such tools that may be used by States at government-owned facilities, such as those operated by the Civil Aviation Authority, are described below.

3.3.1 POWER PURCHASE AGREEMENT

Power purchase agreements are long-term contracts for the purchase of power. They can be particularly important for renewable energy facilities that have a high upfront capital cost, but a low long-term operating cost due to its free fuel component. A long-term contract specifies the annual price to be paid for electricity and the term of the contract. The contract ensures a long-term revenue stream for the facility owner and therefore, is critical to securing project financing.

Government entities and airports can especially benefit from long-term contracts and the associated stable prices afforded by renewable energy. Airports are established land-uses that can benefit from long-term investments. Renewable energy purchased under a long-term contract can provide a guaranteed, stable, non-escalating purchase price allowing for more certain annual budgets. This is particularly useful for airports given the high percentage of airport operating costs that are derived from energy.

3.3.2 EQUIPMENT LEASE

Equipment leases, as opposed to equipment purchases, can provide financial benefits to airports in jurisdictions that offer tax incentives for low carbon emission projects. This occurs because the private company providing the equipment can take financial advantage of the tax incentive and pass some of that savings on to the airport, which typically, as government-owned facilities, cannot otherwise monetize a tax credit because it does not pay taxes. This type of arrangement can be made for renewable energy projects where the installer owns the facility and leases the equipment to the airport. Lease payments are made by the airport to the equipment provider that are equal to the payments previously made to purchase electricity from the utility, such that there is no financial impact on the airport. Once the lease company pays off the cost of the equipment plus a rate of return, the facility can be owned by the airport.

3.3.3 LAND LEASE

In the case of a land lease, the airport leases land to a private developer to construct a low carbon project. The airport receives a lease payment similar to that which could be paid by any other airport tenant for a hangar or restaurant.

Land leases have been developed for renewable energy developers to construct and own facilities on airport property. These projects may also be structured with a power purchase agreement where, instead of receiving a regular lease payment, the airport purchases the electricity produced by the facility at a discounted rate thereby receiving a financial benefit from the lease.

3.4 INTERESTED PARTIES

Energy policy affects many different interest groups throughout society. The following is a brief summary of some of these parties and their interests.

3.4.1 NATIONAL GOVERNMENT

The national government seeks to develop policy that encourages the use of energy in a manner consistent with national interests. The national government can also establish leadership in the areas of energy including renewable energy.

3.4.2 PUBLIC UTILITIES

Public utilities may generate and distribute public resources, including energy and water. They may have a responsibility to ensure that the supply of such resources is reliable and cost-effective. In regulated markets where the utility owns electricity generation, it will be significantly impacted by energy policy that supports new generators into the market, increasing competition. In addition, renewable energy development within the utility's service territory will affect the amount of electricity supply sold to customers, a direct impact on the utility's bottom line. Energy policy must balance the public interest in increasing competition and demand for renewable energy, with impacts on existing suppliers and associated businesses.

3.4.3 FUEL SUPPLIERS

In deregulated markets, private companies compete to generate power cost-effectively and deliver reliable energy. Even in such markets, fossil fuel sourced power comprises the majority of the supply. Where energy policies seek to incentivize renewable energy, existing fossil fuel suppliers and markets may be impacted. Energy policy must consider the potential impacts on communities and businesses to ensure a smooth transition to alternative sources.

3.4.4 ENERGY CONSUMERS

Consumers include government, businesses, and residences. Changes in energy supply may have a direct impact on consumers. Any changes must preserve and improve reliability of supply. However, modifications in the type of supply (e.g. more renewable energy) can have a long-term impact on supply and prices which need to be considered when developing energy policy.

3.5 EXAMPLES OF ENERGY POLICY

A number of examples of energy policies are included in a recent World Bank publication about sustainable energy and regulatory processes.[30] A few are summarized below.

3.5.1 FEED-IN TARIFF PROGRAMMES

Austria, Finland, Japan, Malaysia, and Ukraine have FIT programmes for which companies can register. These programmes provide generators with a guaranteed price of electricity, which varies by technology, based on market rates ensuring that developers earn a market competitive return on investment.

Gaining access to a FIT programme can vary among States. In Malaysia, a generator can register online and pay the application fee to become registered within seven days. In Austria, generators obtain an eco-electricity plan decree approval to qualify for FIT support within 10 days. Waiting times in other States can be longer. In Japan, obtaining the FIT certification from the Ministry of Economy, Trade, and Industry takes on average 62 days.

3.5.2 ENERGY STANDARDS AND PRICE PREMIUMS

Denmark and the Netherlands offer price premiums for certain type of renewable energy generation. As an example, to receive the price premium in Denmark, a wind energy project has to register with two different programmes under the Promotion of Renewable Energy Act. First, a loss of value programme compensates citizens for reduced property value due to a wind energy project in their vicinity (4.5 km or less from the nearest turbine). Second, project developers have to offer 20 per cent of a project's shares to local residents. The offers must be made available for a minimum of eight weeks and must take place before grid connection of the project. If any shares are left, they must be offered for sale to residents of the municipality where the turbine is located (or with a coastline closest to the turbine). This approval is necessary to receive price premiums, but cannot stop a project. Both these programmes increase local buy-in for renewable energy solutions and help cut project delays stemming from local opposition.

3.5.3 SOLAR INITIATIVE IN CHAD

The government of Chad has launched a new initiative to develop its abundant solar resources. This has included setting up the Renewable Energy Agency of Chad and tasking it with mobilizing investment for renewables. Several large solar projects are under development with two projects in the range of 40 to 60 MW. While not yet constructed, these projects have completed four procedures, including signing a memorandum of understanding with the Ministry of Energy, submitting a feasibility study to the Ministry and the local utility, conducting an Environmental Impact Assessment, and signing a Power Purchase Agreement. Completing these procedures took the developers an average of 541 days. The European Investment Bank has been central to financing several of these projects as described on their website. [31]

3.5.4 INCENTIVES FOR ENERGY-INTENSE INDUSTRIES IN SWEDEN

Energy efficiency can be imposed through energy standards or encouraged through market-based programmes. Sweden's programme for improving energy efficiency in energy-intensive industries (PFE) has proven a good example of a market-oriented energy efficiency policy approach.

Created by the 2005 Energy Efficiency Act, the PFE is a voluntary programme for industrial companies that exceed either of these thresholds: energy product expenditures equivalent to at least 3 per cent of its production value; or total energy and CO_2 tax for the company amounts to at least 0.5 per cent of its added value.

Companies can be exempted from the EU energy tax (an additional tax on industrial process-related electricity consumption) if they demonstrate investments in an energy management system. The intent is that companies should improve their electricity use efficiency without being subject to taxes that could hurt their international competitiveness. The energy efficiency improvement measures taken as a result of the PFE are expected to give the same effect as that of the EU energy tax.

Since its inception, the average payback period on investment for each participating company has been under three years. The PFE has resulted in estimated electricity savings of 1.45 TWh annually. A summary of the program is available from the IEA.[32]

3.6 ENERGY POLICY OVERVIEW

Improvements in the use of energy can lead ICAO Member States toward achieving their objectives of reducing international aviation CO_2 emissions. Changes in energy use can also reduce aviation operational costs and risks.

There are a number of energy policy measures that can help increase ICAO Member States' use of alternative energy sources. The adoption of such policies may require coordination with a broader constituency of stakeholders who will also realize benefits of renewable energy and a diversified energy supply. ICAO Members States may need to explore energy policy with a wide range of interested parties.

Many States are undertaking energy policy reforms, which can assist them in achieving their international aviation emission reduction objectives. Successes have been demonstrated and ICAO Member States should identify potential opportunities in their State Action Plan on CO_2 emissions reduction activities from international aviation.

4.0 CASE STUDIES OF ORGANIZATIONAL FRAMEWORKS

There are a number of States that have evaluated their aviation organizations and made changes to better accommodate environmental programmes. A general structure for organizational frameworks is provided, followed by examples from Member States.

4.1 GENERIC MODEL

A Member State has identified a need to improve its organizational structure at the civil aviation authority to support new and emerging environmental issues associated with aviation activities. The ICAO Member State has been developing environmental standards and has contributed to ICAO's development of new SARPs and the responsibility of Member States to implement SARPs through the civil aviation authority.

The Member State has assessed the various commitments made through ICAO and sought to review the existing organizational structure within its Ministry to determine the best way to support environmental programmes. It identified two primary options: (1) integrate an environmental position into each Directorate; and (2) create a separate environmental division. The benefits and challenges of each option were analysed as described below.

Option 1: Integrate environment within existing Directorates

Each directorate has different responsibilities, from ATM to aircraft certification, to airport operations. While not the primary focus of a directorate, environmental issues touch on all areas of aviation. Option 1 would embed environmental expertise within each directorate such that environment would be specifically addressed by and within the directorate, instead of across the various directorates.

The primary benefit of this option is that environmental impacts would be considered as part of the decision-making of each directorate of CAA. The challenges of option 1 are primarily related to an isolation of environmental issues within each directorate rather than a strategic approach across the CAA. In addition, resource allocation may be inefficient given the varying needs of environmental expertise between directorates, resulting in overlap in some cases and gaps in others.

Option 2: Create a dedicated environmental unit

The second option is to develop a separate environmental unit to work across all directorates on environmental issues. In this manner, the environmental unit can assess the entire civil aviation authority's environmental issues and develop an organization-wide strategy to assess impacts relative to standards and implement best practices to achieve and maintain standards. As the designated environmental authority for the agency, it would also be capable of working internally with the directorates, and externally with aviation stakeholders, to gather input for programme development and implementation. By establishing the unit as a separate coordinating group, it should be able to obtain authority from the top of the organization to demonstrate the importance of the State's environmental commitments through ICAO and the emphasis needed to coordinate throughout the agency on programme development. The effective internal coordination would be maximized if the environmental team would report directly to the Head of the civil aviation authority.

The primary benefits of this option include the ability to establish an integrated strategy across the authority with executive level direction and support, as well as efficient allocation of environmental resources oriented to relevant directorate based on environmental priorities. The main challenge would be gaining strong inter-directorate support and action when the directorate has other fundamental programmatic objectives associated with aviation activities.

Recommendation

A recommendation was made to create a dedicated environmental unit as outlined in option 2. One of the first objectives of the environmental unit was to establish a baseline assessment of CO_2 emissions resulting from international aviation in the Member State and identify possible mitigation measures as part of the State's Action Plan on CO_2 emissions reduction activities. Such a project would also provide an opportunity to engage aviation stakeholders on a joint project and demonstrate the added value of a dedicated environmental unit.

4.2 MEMBER STATE CASE STUDIES

Member State actions associated with organizational frameworks in the civil aviation authority are presented below. Examples have been provided by Cameroon, Dominican Republic, Gabon, Indonesia, and Kenya.

4.2.1 CAMEROON

In Cameroon, the Ministry of Environment, Protection of Nature and Sustainable Development (MINEPDED) is in charge of ensuring that all other Ministries, non-governmental organizations (NGOs), and international governmental organizations (IGOs) respect the Government's policies on environmental protection within their respective domains. The Cameroon Civil Aviation Authority (CCAA) is aware of the adverse effects of its activities on the environment and climate change and works closely with the Ministry of Transport to address these issues.

Decision N° 0001540/MINT of 15th November 2006 relating to acoustic certification and aircraft gas emissions was created by the Minister of Transport. This was the pillar that motivated the Management of the CCAA for the need to put in place a Service for Environmental Protection (SEP) in a bid to assist in working out modalities to reduce the impact of civil aviation activities on the environment.

Created by Law 2013/010 of 23 July 2013, stating the legal basis of civil aviation activities in Cameroon, the CCAA is in charge of coordinating and supervising the civil aviation activities in Cameroon. Decree N° 2015/232 of 25th May 2015 was further established relating to the organization and functioning of the civil aviation authority. Environmental issues have increased in importance within the CCAA. This stems to 2010 with the ICAO Assembly Resolution A37-19 encouraging States to voluntarily elaborate and submit an Action Plan on emissions reduction towards the achievement of ICAO global climate change goals. In 2012, the Service for Authorization and Environment (SAE) was created under the Department of Air Transport and Security. One of its responsibilities was to ensure a liaison with other services for Cameroon's Action Plan to be submitted before the deadline of June 2015, as was required. The National Action Plan Team (NAPT) was created to elaborate and submit the said Action Plan. It should be noted this was an initiative of the SAE which served as an example for other Member States of the Economic Community of Central African States (ECCAS) to emulate. Since 2014, the CCAA has fully participated in the ICAO-EU assistance project on capacity building on the reduction on CO_2 emissions in international aviation. Currently, they are closely following up all the discussions on MBMs and CORSIA until such time that the State of Cameroon will be ready to join the scheme. Due to the evolution of the numerous activities from this joint project, coupled with some of the Annex 16 SARPs, the SAE was split into two entities in February 2017 when a new organization chart for the CCAA was adopted. This created a Service for Authorization and a Service for Environmental Protection (SEP). It went fully operational in March 2017. The Focal Point of the ICAO-EU assistance project was appointed the Chief of the SEP. Both services are attached to the Division of Air Transport.

Apart from the implementation of the selected mitigation measures from Cameroon's Action Plan for emission reduction, several other projects have also been anticipated including an effort to enhance environmental policy for the protection of the airport environment considering the experience gathered from the above project. Several studies have been carried out at the airports to identify some of the environmental problems faced which has led to the establishment of terms of references (TORs) for environmental audits, and impact and risk assessments to be carried out. The SEP is also working in collaboration with other Departments of the CCAA and the MINEPDED on issues concerning noise control, land use management and bird strike and wildlife prevention at the airports. It is also looking forward to carrying out a project on local air quality in the future. It is equally involved in the World Bank assistance project on security at the airports and has participated in several working sessions on the environmental impact and risk assessments for the construction of a security fence at the airports and auto routes to and from the airports.

The missions of the SEP have been tailored in accordance with Decision N° 0001540/MINT of 15th November 2006, using annex 16 as a guide, and include as shown in **Figure 4-1**:

- The monitoring of the national policy on the protection of the environment from aircraft noise and emissions;
- The development and updating of guidance materials, procedures and regulations for environmental protection in the civil aviation sector;
- The implementation of environmental standards at the airports.

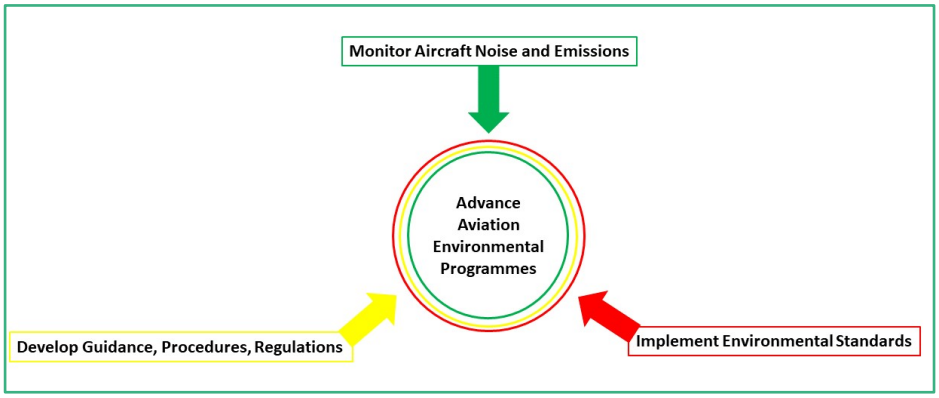

FIGURE 4-1
Aviation environmental missions of the Cameroon Civil Aviation Authority (Source: author)

The SEP is currently coordinating with the Stakeholders to ensure that the mitigation measures selected during the development of Cameroon's Action Plan are fully implemented. Following the Result Oriented Monitoring (ROM) that took place in April 2017, it was determined that about 55 per cent of the selected mitigation measures had been implemented. The SEP seeks complete implementation of these measures to support the development of procedures and regulations on aircraft emissions by the end of the ICAO-EU joint assistance project. A NAPT meeting, scheduled in the fall of 2017, will evaluate the level of implementation of Cameroon's Action Plan for CO_2 emissions reduction.

While environmental policy and regulation is in development, the SEP has engaged in other environmental projects including:

- implementation of an environmental audit at the airports, the result of which will enable the onset of the establishment of an environmental policy and regulation for the civil aviation sector, as environmental issues were not yet taken into consideration during the construction of the airports at the time;
- collection of monthly data on traffic and fuel consumption from the States' Airlines and calculating the monthly reports on CO_2 emissions. This is achieved thanks to the Aviation Environmental System (AES);
- preparation of detailed information that will encourage the State of Cameroon to join the CORSIA scheme in the future;
- participation of the CCAA in COP23 in a bid to gather ample information for the elaboration of future climate change projects for the aviation sector;

- anticipating the proposal of a three-year strategic plan for the implementation of concrete environmental standards at the airports as required in one of the missions attributed to the SEP;
- collaboration with other Departments of the CCAA, the Stakeholders and other institutions to mitigate the impact of noise at the airports;
- coordination with the Department of Aviation Safety of the CCAA other external partners for the installation of equipment for the prevention of bird strike and wildlife at the airports; and
- examination of the difference between the above mention Decision created on noise and aircraft engine emissions and its compatibility with the provisions stipulated in Annex 16.

Considering the broad nature of the above activities and future projects, and for a better performance in their implementation, the Division of Air Transport has proposed to the Management of the CCAA as requested two bureaus which will be attached to the SEP, namely the bureau of environmental norms and the bureau of sustainable development.

The respective activities of these bureaus have been elaborated and submitted to the management. It will go operational once it is approved by the Board of Directors.

It is important to note that gender equity is a central component of the development of the CCAA in its environmental and other programs. Since its creation in 2000, the CCAA has adopted as part of its recruitment policy, a gender approach based on competence. There are over 500 staff at the CCAA distributed over the 10 regions in Cameroon with 40 per cent being women and 25 per cent at the managerial level. The Director General of the CCAA is a woman, with two women as Heads of Departments, five women as sub-Directors, 18 women as Chiefs of Services and many women who are Senior Staff. It is also important to note that a few other female staff of the CCAA are Focal Points of some other ICAO and IATA projects.

4.2.2 DOMINICAN REPUBLIC

The Dominican Republic Civil Aviation Institute (IDAC) is the civil aviation authority of the Dominican Republic. It was a founding Member State of ICAO. IDAC is one of the autonomous State agencies that regulates and promotes civil aviation in the Dominican Republic; it is the air navigation service provider, contributing to the economic development of the nation.

IDAC is committed to improving established standards, complying with current regulations to raise the quality, safety and sustainable levels of air transport, and contributing to the development of the thriving tourism industry, the main economic activity of the Dominican Republic.

IDAC has been progressing toward making organizational frameworks to administer environmental programmes associated with international civil aviation and coordinating with relevant stakeholders. The IDAC in connection with the ICAO initiatives on environmental protection, and supported with the ICAO-EU joint assistance project, in 2014 established a temporary National Team to delimitate functions and rules and identify priorities for aviation and the environment. The team included expertise from aviation and environmental departments and at least 25 relevant stakeholders such as national airlines, airports, air navigation services and other service providers. The National Team formalized its work through the development of the ICAO State Action Plan on CO_2 emissions reduction.

After preparing the initial Action Plan, the National Team designed and created an environmental unit within the IDAC to implement the Action Plan and replaced the temporary National Team created. The environmental unit was named the Sustainable Development Unit (SDU) to avoid confusion on roles and scope with similar departments within the Environment Ministry or the National Climate Change Council. The SDU will support the IDAC and the aviation sector in the State to meet the goals established by ICAO and fulfil the responsibilities for moving on the international standards, policies and guidance materials for integrated action at national level regarding environmental protection within a broader framework of cooperation and partnership. The SDU is supported by an institutional Environmental Committee which includes representatives from each of the specific technical areas within the IDAC including airports, planning, air navigation, flight standards, and legal, with optional participation from other disciplines such as finance and human resources, as necessary. The SDU is acting as the secretariat of the IDAC Environmental Committee and it also has active and direct participation and involvement from the office of the General Director through the Deputy General Director to ensure that all the institutional levels of the organization are involved with the SDU activities from the highest decision-making level. The proposed organization of the SDU within the IDAC is shown **Figure 4-2**.

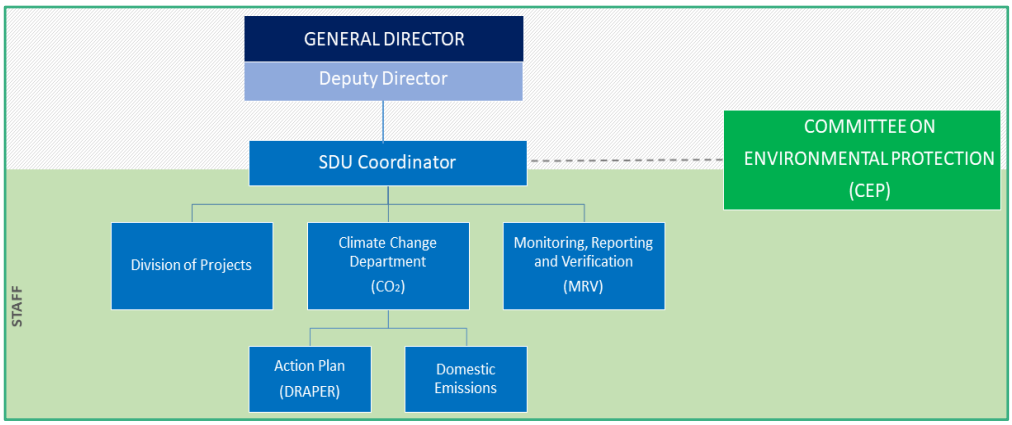

FIGURE 4-2
A modified organizational structure incorporating environment in Dominican Republic Civil Aviation (Source: Dominican Republic Civil Aviation Institute)

In implementing the Action Plan and identifying mitigation projects, the Environmental Committee through the SDU, agrees on projects, assigns the implementation of the project to a particular IDAC department as applicable (e.g. implementation of a CDA procedure would be most applicable to air navigation), and the SDU would monitor progress of implementation.

4.2.3 GABON

For the Civil Aviation Authority of Gabon (Agence Nationale de l'Aviation Civile du Gabon - ANAC Gabon), environmental protection is a crucial challenge to be addressed. In order to be more efficient and to fulfil its environmental goal, an environmental dedicated service (Service de protection de l'environnement - SPE) has been established to develop environmental regulations and later to proceed to the relevant audits in order to reduce the civil aviation impacts to the environment.

Implemented by the Decree N° 452/MPITPTHTAT dated from 19 April 2013 adopting the status of the ANAC Gabon, the SPE has been established in the Airports and Aeronautic Equipment Department. The SPE is responsible for monitoring, evaluation, analysis and advice for the implementation of environmental protection policies related to civil aviation of Gabon. The specific areas of focus are highlighted in **Figure 4-3**.

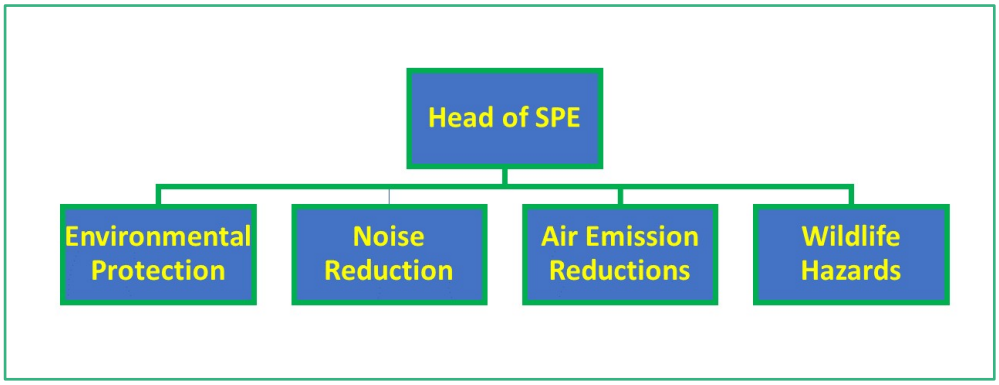

FIGURE 4-3
Areas of responsibility for the Gabon Civil Aviation Authority's Service de protection de l'environnement – SPE (Source: author)

Since 2014, ANAC Gabon has participated in the ICAO-EU capacity building and assistance project for the CO_2 emissions reduction from international civil aviation. In the frame of this project, several activities have been initiated and implemented by ANAC Gabon that supports the SPE in the development of a strong environmental policy on CO_2 emissions reduction from international aviation.

As a result, in 2016, the SPE was established and one of the Focal Points nominated for the ICAO EU project was assigned to lead the service. Currently, the SPE is composed of one person but ultimately two additional members will be nominated; one to ensure the reduction of noise nuisance and the other to be in charge of the air transport related atmospheric nuisances.

The SPE's responsibility includes the field of structures, airport buildings and related equipment, air navigation services, airworthiness, and transport safety. The Head of the SPE, in accordance with article 60, Decree 452, is responsible for:

- participating in the development and implementation of the environmental protection regulation, in collaboration with the other services involved;
- developing the environmental files related to aircraft noise reduction at airports and heliports;
- preparing the files related to aircraft engines' emissions reduction;
- developing the necessary agreements for the environment-related missions;
- collecting and monitoring the information related to environmental protection;
- contributing to safeguarded State's interests related to environmental protection;
- developing and executing its budget;
- contributing to the development of the guidance materials and procedures on avoidance of wildlife hazards and the environmental protection at airports;
- developing and implementing policy on noise reduction and aircraft engines' emissions reductions;
- preparing new regulations and legislative texts related to environmental protection and wildlife hazards;
- preparing the strategic direction related to environment;

- proposing and implementing strategic monitoring based on environmental databases; and
- identifying the differences between national regulations and ICAO Annex 16 related to environmental protection.

While the regulatory framework for aviation environmental protection is still under development, several activities and actions have been initiated including:

- contributing to the implementation of regulatory monitoring on the improvement of civil aviation environmental performance on reduction of CO_2 emissions;
- collecting traffic and fuels consumption data on a regular basis from airlines companies for the preparation of the Gabon CO_2 emissions reports;
- monitoring the implementation of the mitigation measures selected in the State Action Plan submitted to ICAO in April 2016 and ensuing revisions;
- contributing in the preparation of Gabon to participate in the pilot phase of CORSIA;
- supporting other Focal Points from Senegal and Togo to implement their national Action Plan Team and fuel consumption and air traffic data collections;
- participating in the National Council for the Climate of Gabon activities representing the civil aviation;
- contributing to implementation measures to address wildlife hazards; and
- implementing the functional objectives for the environmental protection domain and definition of the SPE tactical objectives for the upcoming year.

In the context of its recruitment policy, the ANAC Gabon takes a gender based approach for the same level of expertise and skills and qualifications. Thus, to date, 41 per cent of the 81 ANAC agents and 29 per cent of the 48 senior executives are women. ANAC Gabon promotes gender equality and that is why, at equal competence, ANAC Gabon has nominated the head of the environmental protection Service within the Airports and aeronautic equipment Department, who is already State Action Plan Focal Point in the ICAO-EU assistance project, as of 2015.

4.2.4 INDONESIA

A national policy in Indonesia central to environmental protection was announced through Presidential Decree No. 61 of 2011 as the National Action Plan to Reduce Greenhouse Gases (RAN-GRK). This policy established specific emission targets by sector such as transportation, which included a subset for aviation, and required annual monitoring, reporting, and verification. At the direction of the decree, the Ministry of Transportation issued Minister of Transportation Decree No. 201 of 2013 on RAN-GRK Transport Sector which established the programmes and targets for the RAN-GRK relative to the transportation sector.

To implement the programme in the aviation sector, the Directorate General of Civil Aviation (DGCA) established the RAN-GRK Working Group through DGCA Decree No. KP 24, 2015. Members of the Working Group are comprised of representatives of each individual Directorate within the DGCA. Furthermore, ICAO and the DGCA established formal cooperation through the Management Service Agreement (MSA) ANNEX 5 INS13801 project, as a technical assistance project for the implementation of the National Action Plan for Greenhouse Gas Emissions in the Air Transport sector.

The assessment of organizational modifications necessary to support implementation of RAN-GRK in Indonesia recognized the importance of national and international policies, and standards for aviation in environmental programme development. In addition, it determined that, as a basis, environmental issues such as the technical conditions and standards on emissions and noise, specification of engine, performance-based navigation, eco-airport programme, etc., cut across all sectors of the DGCA. While technical issues must be addressed by the respective technical Directorates (e.g., Directorate of Airworthiness and Aircraft Operations, Directorate of Air Navigation, Directorate of Airports and the Directorate of Air Transport), environmental issues resulting from each have commonality. Thus, it was recommended that environmental issues be managed under the direction of the Secretary of the Directorate General, with technical implementation carried out by each respective Directorate.

A recommendation has been made to establish a Division of Cooperation and Environment under the Secretary of the Directorate General. Recognizing the need to coordinate aviation environmental programmes both on a multi-national level as well as across directorates on the national level, the proposed re-organization included three subsections: ICAO Desk, Technical Cooperation and Policy, and Environmental Cooperation and Sustainable Aviation. The ICAO Desk would be responsible for coordinating all work between the DGCA and ICAO, including formal participation of Indonesia as a Member State, responding to ICAO requests for comment and information, and the translation of ICAO policies and standards for implementation in-State. The Technical Cooperation and Policy subgroup would coordinate, prepare, perform administrative cooperation regarding technical and policy issues between the DGCA and various agencies, both among government agencies and non-governmental, in the State and abroad, including domestic government agencies, foreign government aviation agencies, international air transportation organizations, and national air transportation and pilot groups. The Environmental Cooperation and Sustainable Aviation subgroup would coordinate administrative cooperation in the field of environment and sustainable aviation, between the DGCA and the various agencies, both government and non-governmental, in the State and abroad, including key responsibility for environmental programmes such as MRV of emissions reductions and developing technical information to support the ICAO State Action Plan.

4.2.5 KENYA

The Kenya Climate Change Act ("the Act") No. 11 of 2016 requires state departments and national government public entities to *report on sectoral greenhouse gas emissions for the national inventory* and to *designate a unit with adequate staff and financial resources and to appoint a senior officer as head of the unit to coordinate the mainstreaming of the climate change action plan and other climate change statutory functions and mandates into sectoral strategies for implementation*. Kenya is also an ICAO Member State and as such, strives to adopt and comply with ICAO SARPs, including those associated with climate change. Kenya's commitment to an environmentally sound international aviation sector at international level will be reflected at national level, with the re-structuring and strengthening of the environmental capabilities of the Kenya Civil Aviation Authority (KCAA).

Environment, climate change and occupational health and safety-related issues have been addressed by designated KCAA staff undertaking these tasks on top of their regular activities. This has significantly limited the scope, efficiency and sustainability of these actions, as well as the consideration of environment in the existing and planned activities of KCAA. In order to address this gap, an Environment Unit will be established as an independent entity within KCAA, reporting directly to the Director General.

Some of the issues that the Environment Unit will be responsible for associated with addressing international aviation emissions include the following:

- ensure that KCAA complies with existing national and international environmental regulations, guidelines and standards including relevant decisions by ICAO regarding the implementation of a global market-based measure (GMBM) scheme for international aviation;
- develop and propose policies, standards, guidelines, regulations and legislation to ensure that the environmental regulatory framework of KCAA is aligned and compliant with relevant national, and international conventions of which Kenya is a signatory;
- strengthen environmental governance and strategic planning in environment within KCAA by developing, implementing and updating an Environment Policy, a Strategic Environment Assessment (SEA) and an Environment Action Plan for KCAA;
- monitor the implementation of CO_2 emissions mitigation measures in accordance with the Kenya Action Plan for CO_2 Emissions Reduction in Aviation;
- coordinate compliance with Climate Change Act No. 11 of 2016, by reporting to the relevant Government entity on greenhouse gas emissions generated by the aviation sector;
- coordinate the collection of data from relevant stakeholders and manage activities related to the inventory of CO_2 emissions in the aviation sector;
- liaise with the relevant government agencies and international organizations on environment and climate change matters; and
- represent the Authority in key relevant national, regional and international events.

The Environment Unit will be headed by an Environment Manager, who will be assisted by six other key staff, all full-time KCAA staff members based in KCAA Headquarters in Nairobi. The functions undertaken by the Environment Unit will cover tasks currently lying within the scope of other departments such as Aviation Safety and Security Regulation (e.g. coordination of the Action Plan for CO_2 emissions reduction), and Corporate Services (e.g. data collection and analysis). The Environment Unit will therefore be a cross-cutting entity within KCAA that should report directly to the DG. An organizational chart of the proposed structure is shown in **Figure 4-4**.

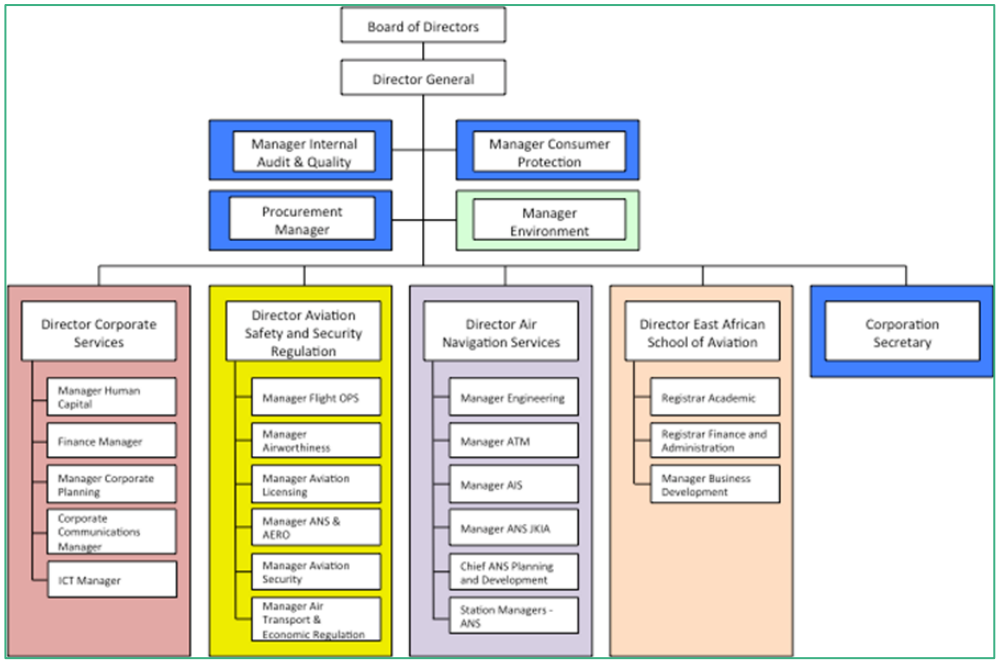

FIGURE 4-4
Revised operational structure for the KCAA (Source: Kenya Civil Aviation Authority)

KCAA set up an Aviation Environmental Working Group (AEWG) in 2012 which prepared and submitted Kenya's Action Plan for the reduction of CO_2 emissions in aviation sector to ICAO in December 2015. The proposed reorganization of the KCAA will include institutionalizing the AEWG as the National Aviation Environmental Committee (NAEC) approved by the Cabinet Secretary of the Ministry of Transport.

The KCAA is currently in the process of approving and implementing these organizational structure changes.

CONCLUDING SUMMARY

ICAO Member States are encouraged to develop a State Action Plan to inventory emission sources and levels from international civil aviation, and develop associated measures for reducing them over time. As part of each State's programme development, it should consider its existing organizational structure and regulatory programmes, and identify areas of modification that will help with the development and implementation of the Action Plan and the measures therein.

Changes to organizational frameworks are primarily associated with increasing the capacity of the civil aviation authority to address environmental issues, including emission reduction measures. As much of the environmental programmes and policies are being developed collaboratively by ICAO Member States with some potential additive and complementary measures from national governments, it is important for the civil aviation authority to build capacity in its communications with ICAO such that it can facilitate access to technical assistance and guidance. This may include an ICAO liaison within the civil aviation authority environmental staff to ensure that all relations are supported and enhanced. Beyond that, civil aviation authority needs to build specific capacity in the areas of Action Plan implementation, monitoring and tracking. Structuring the civil aviation authority for monitoring, reporting and verifying CO_2 from international civil aviation is the first step to prepare the State for the participation in CORSIA.

On the regulatory side, energy policy and programmes provide opportunities for Member States to expand the availability of clean electricity sources to power aviation activities, including those specific to international aviation. The civil aviation authority can exist in a supporting role in advocating for energy reform and incentive measures. In doing so, it may be able to attract private partners to reduce energy costs, improve supply diversity, and minimize emissions.

Member States should incorporate regulatory and organizational frameworks into the development of a State Action Plan on CO_2 emissions reduction activities for International Aviation. At a minimum, Member States should have identified a Focal Point to lead efforts associated with international aviation emissions reductions. Where applicable, Member States may request ICAO assistance in developing programmes and even establishing an environmental unit within the Civil Aviation Authority. It facilitates the liaison between ICAO and the Civil Aviation Authority for the development and implementation of the programmes most appropriate for the State to reduce international aviation emissions. in light of their State Action Plan.

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