GRUPO AEROPORTUARIO DE LA CIUDAD DE MÉXICO

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Mexico City Airport Trust NAICM Green Bond Reporting



1. Introduction

Grupo Aeroportuario de la Ciudad de México, S.A. de C.V. (GACM) is responsible for the preparation and providing a fair representation of this Green Bond Framework as of September, 6th 2016, which will cover the issuance of Green Bond from Mexico City Airport Trust.

For each Green Bond issued by the Mexico City Airport Trust, GACM management asserts that it will adopt the use of the proceeds eligibility criteria and processes and policies as set out in the Mexico City New International Airport (NAICM by its Spanish acronym) Green Bond Framework as outlined in Figure 1.

This report describes an outline of the green works that are currently underway for the Airport program development paying particular attention to currently designed elements and the initial construction and site preparation activities.

This report will be updated quarterly to report on specific activities which have occurred in the report time-frame and to show development of the performance indicators.

Figure 1 - NAICM Green Bond Framework



2. Green Bond Eligibility Categories

The eligibility categories are focused in the planning, design and construction of the NAICM project according to green building & environmental best practices standards.

Six categories were selected to describe the different areas of sustainability focus for the project scope. These are described below:

• Eligibility Categories

- 1. Sustainable Buildings
- 2. Renewable Energy
- 4. Water and Wastewater Management
- 5. Pollution Prevention and Control
- 3. Energy Efficiency
- 6. Conservation and Biodiversity



The project is utilizing the rating system Leadership in Energy and Environmental Design version 4 (LEED v4). The rating system seeks to enhance architectural and engineering designs and construction processes to reduce the environmental impacts of the building and its occupants, improve the indoor environmental quality and minimize changes to natural systems. Four of the airport buildings on the site are being designed and constructed to meet these LEED requirements, in particular the 743,000 m² Passenger Terminal Building.

The project undertook Environmental Impact Assessment, commonly known in Spanish as *Manifestación de Impacto Ambiental* (MIA), as it is required for all new major projects in line with SEMARNAT (*Secretaría del Medio Ambiente y Recursos Naturales*) requirements. The MIA is an instrument of environmental policy that is required to present all information about the environmental conditions of the site and analyze and outline requirements for the works and activities that could cause environmental or ecological imbalance.

NAICM Green Bond Reporting



Figure 2 - Site polygon showing location of main program elements per eligibility criteria.

2.1. Categories Description

The project must meet one or more of the following eligibility criteria:

1. Sustainable Buildings:

Any project for an existing or new building;

- (i) that has received, or expects to receive based on its design, construction and operational plans, rating according to third party verified green building standards such as LEED Silver or higher, or an equivalent rating scheme; and
- (ii) that has achieved, based on third-party assessment, a reduction in energy consumption of at least 15% relative to industry standards and benchmarks such as ASHRAE 90.1 or equivalent.

2. Renewable Energy:

Development, construction, installation, operation and upgrades of;

- (i) equipment or facilities wholly dedicated to renewable energy generation; or
- (ii) wholly dedicated transmission infrastructure for renewable energy generation sources.

The projects must meet the definitions of renewable energy outlined in Mexico's Energy Transition Law (Ley de Transición Energética) and may include wind, solar, tidal, geothermal, biomass and run-of-river hydro projects.

3. Energy Efficiency:

Development, construction, installation, operations and upgrades of any projects (products or technology) that reduce energy consumption or improve resource efficiency in airport management and operations, including but not limited to;

- (i) projects that enable energy performance monitoring and modelling such as design and installation of computer controls, sensors, or building information systems; or
- (ii) projects that optimize the amount and timing of energy consumption and minimize peak loads such as design and installation of metering, peak load shedding, or fuel switching systems;
- (iii) projects that involve installation, maintenance or replacement of energy efficient heating, ventilation, air-conditioning, cooling, lighting and electrical equipment.

4. Water and Wastewater Management:

Development, construction, installation, operations and upgrades of any projects (products or technology) that reduce water consumption or improve resource efficiency in airport management and operations, including but not limited to;

- (i) new or existing facilities that are used for the collection, treatment, recycling, or re-use of water, rainwater, wastewater or sewage; or
- (ii) infrastructure for flood prevention, flood defense or storm-water management such as wetlands, retention berms, reservoirs, lagoons, sluice gates, drainage systems, tunnels and channels.

5. Pollution Prevention and Control:

Development, construction, installation, operations and upgrades of any projects (products or technology) that reduce and manage waste generated in airport management and operations, including but not limited to:

- (i) new or existing facilities, systems and equipment that are used for the collection, treatment, recycling or re-use of solid waste, hazardous waste or contaminated soil; or
- (ii) new or existing facilities, systems and equipment that are used to divert waste from landfills and reduce emissions from transport of waste.

6. Conservation and Biodiversity:

Any projects for;

- (i) reforestation and ecological restoration;
- (ii) creation and protection of forests and wetlands; or
- (iii) monitoring and mitigation of adverse impacts on flora and fauna such as potential impacts from construction and noise pollution.

3. Use of Proceeds Summary

Description	Amount USD
Net Proceeds from Green Bonds	\$5,764,394,697

Allocated Amount to each Eligible Category (USD)						
Category	1	2	3	4	5	6
USD	Sustainable Buildings	Renewable Energy	Energy Efficiency	Water and Waste Water Management	Pollution Prevention and Control	Conservation and Biodiversity
Disburse Amount	\$440,177,611.95	\$420,133.53	\$13,264.49	\$18,158,316.49	\$856,394.79	\$21,702,135.10
Total	\$481,327,856.35					

Description	Amount	
Amount Available for Allocation	5,283,066,841	

Note: Values are shown in dollars. The exchange rate used from MXN to USD is the applicable rate at the time for each disbursement being paid.

4. Commissioning process (Cx) for LEED buildings of the NAICM

4.1. Introduction

Complete commissioning (Cx) is an ever-on-going process from initial design through construction and operation of a system or facility. The process is developed to provide a method of checking and ensuring that systems and facilities are designed to meet the client's and end-users' wishes and requirements and later putting in place on-going procedures and tests to review not just the correct set up of a specific system but also the overall functionality of multiple systems within a single facility to meet the original users' requirements.

For NAICM, the following systems are being commissioned by a specialized LEED commissioning agent, also known as (CxA):

- Sistemas del Edificio: HVAC, eléctrico, plomería y sus sistemas de monitoreo y control
- Sistemas de energía renovable
- Diseño y desempeño de la envolvente

These systems are important for LEED Cx activities since they have a large impact on the overall performance of a building, especially with respect to energy and water use. The systems are also interrelated and as such impact each other's performance which needs a holistic approach to ensure overall functionality.

Other more specialized systems, such as the Baggage Handling System (BHS) and the Fire Alarm system, will also be commissioned, though these are interrelated to other systems, they are so in a less integrated way, such as impacting overall energy use and will be commissioned by a specialist contractor.

In order to explain the relationship between the commissioning process and the LEED assessment system, figure 1 shows the mandatory pre-requisites and the optional credits that qualify in the Energy and Atmosphere Category.

Figure 1 - LEED2 Categories

LEED Categories





Energy and Atmosphere

ID	Credit or Prerrequisite	Phase
EAp1	Fundamental commissioning and verification (Obligatory-Prerequisite)	Construction
EAp2	Minimum Energy Performance (Obligatory-Prerequisite)	Design
EAp3	Building-level energy metering (Obligatory-Prerequisite)	Design
EAp4	Fundamental Refrigerant Management (Obligatory-Prerequisite)	Design
EAc1	Enhanced commissioning (2-6)	Construction
EAc2	Optimize Energy Performance (1-18)	Design
EAc3	Advanced Energy Metering (1)	Design
EAc4	Demand Response (1-2)	Design
EAc5	Renewable Energy Production (1-3)	Design
EAc6	Enhanced Refrigerant Management (1)	Design
EAc7	Green Power and Carbon Offsets (1-2)	Design

4.2. The importance of Commissioning for the NAICM project

In the NAICM project, the Passenger Terminal Building (PTB), the Ground Transportation Center (GTC), the Air Traffic Control Tower (ATCT) and the Area Control Center (ACC), are seeking LEED ratings; therefore, each of these buildings require the activities specified in the Commissioning and Basic Verification pre-requisite. For the PTB, the intent is to achieve a reduction in water consumption of 50% inside the building by specifying the use of low-consumption units, and a 100% reduction for external uses, implementing a landscaping design of zero water consumption, similarly, the PTB is targeting to save 50% of energy consumption. The Central Utilities Plant (CUP) is also part of the commissioning process, since it is an integral part of the LEED buildings' cooling systems.

The commissioning process is very important for NAICM, since through the assessment, verification, documentation review, tests and training processes, the systems that use the most energy and control the indoor environmental quality will be proved to comply with the owners' requirements. Thus this will maximize the potential use of each system installed and minimize environmental impacts and keep high standards for quality and comfort for users.

It is planned to obtain the Advanced Commissioning Credit in the four buildings, which is focused on developing Commissioning Plans (Cx Plan), Commissioning of the Envelope (BECx), and Monitoring Based Commissioning (MBCx). The commissioning process is led by the specialist Commissioning Authority (CxA) who is directly hired by GACM and they must engage with all project teams such as the design teams and contractors to successfully undertake the process.

4.3. Commissioning Authority

The verification and assessment process is done by a CxA, which is the competent authority to follow-up on the design requirements and the operational needs requested by the project owner. The Mexican company, Revitaliza, is the Commissioning Authority that is verifying the NAICM project. It is worth noting that the CxA works directly for the GACM, who is the NAICM project owner. This allows the CxA to remain impartial, since they are not influenced by the designer or other collaborators.

The CxA is also in charge of verifying that the designs based on International Standards for Construction and Technology Systems, are complied with. The CxA performs different activities in the design, construction and operational stages of the project.

4.3.1. Activities during the design process

In order to commission the systems, the CxA performs different activities that range from advising the user on the development of the Owner Project Requirements (OPR) and by reviewing the Basis of Design (BOD), and then the development and implementation of Cx plans. Since commissioning is a long process in which different entities interact in the development and review of the documents and tests, a timeline is presented with the NAICM project commissioning activities during the design stage, and the key elements that make it.



Figure 2 - Timeline of activities during the design process

Owner Project Requirements (OPR)

Each of the LEED buildings require an OPR. For that, the Project Owner, the Commissioning Agent and the Project Management collaborated in the definition of the requirements for each building. Although the OPR was started in the pre-design stage, this is a live document that can be updated during the project construction. Four documents have been currently made with the specific requirements of each building that attend the needs established by the NAICM Project Owner.

Basis of Design (BOD)

The basis of design are the technical guidelines that describe in a detailed manner, the parameters and considerations of each system that was requested by the Owner in the OPR. Therefore, they are also live documents that update according to the needs of the Owner. In the NAICM project, the Master Architect has been in charge of developing the basis of the four buildings, and the Master Civil Engineer has been in charge of the basis of design of the Central Utilities Plant.

Commissioning Plan

This Plan is developed by the Commissioning Agent and includes the responsibilities of the project team in the coordination of activities. Also, the submittal of documents and testing of the systems, are scheduled therein. The Plan is fundamental to establish the goals and objectives of the commissioned systems, do the tests and report the deficiencies or resolutions of the systems. Such plan is part of the pre-requirement and its development is fundamental during the design stage, since it is through this that activities such as the Monitoring Based Commissioning or that of the Envelope of the Building, are derived (see fig. 3), and that are necessary to comply with the Advanced Commissioning credit.



Figure 3 - Commissioning Plan

It is important to mention that the four NAICM buildings designed to obtain the LEED certification must perform in a mandatory way, the Commissioning Plan described in the pre-requirement. However, the design of the four buildings also intends to obtain the commissioning credit, and for that, it plans to comply with the 4 points of path 2, which poses Option 1 and with the 2 points of Option 2 (see fig. 3). In such a way that the four projects seek to obtain the 6 points of the Advanced Commissioning Credit.

4.3.2. Pre-requirement

The systems assessed by the commissioning for the pre-requisite are focused on efficiency and energy consumption, interior environment quality and durability. Specifically, the systems described in figure 4, are commissioned

Figure 4 - Commissioning Systems



The intervention of the CxA in the pre-requisites is included in two objectives. The first intends to get the ideal means prior to the project execution and the second refers to the design, dimensioning and scheduling of the systems proposed.

- Reduce change orders for equipment and deficiencies within the systems, reduce the corrective actions implemented by the contractors in site, improve the planning and coordination, as well as reduce the energy consumption and operative costs.
- 2) Verify the space temperature and ventilation control to improve health and comfort of users, data control and identify the benefit and lower risk of downtime of the information technology equipment caused by power, cooling or performance issues; defective installation or calibration, or software programming errors that may not be detected until the building is operational.

4.3.3. Credit

To obtain points in the Advanced Commissioning Credit, the CxA must make two additional plans that complement the Commissioning Plan required in the pre-requirement. The processes that qualify for this credit are described as follows.

- Monitored Based Commissioning, which has as an objective to provide the Owner and the Operators automated information about the performance of the systems and equipment during the building operation; it also allows monitoring the energy consumption and detect problems in operation.
- 2) The Commissioning of the PTB envelope consists of doing thermal and air-tightness verification tests of the façade in order to improve the performance in construction and minimize the energy consumption of the systems during the overall life cycle.





Monitoring-based Commissioning (MBCx)

The MBCx is programmed to verify the functioning of the systems during the life of the building. Figure 3 describes the systems assessed by the CxA, as well as the monitoring requirements it has, while the BECx plan assesses the tests for the facade.

While the commissioning plans are developed in the design stage, a large part of the activities described are implemented during the construction stage.

4.3.4. Activities during the construction process and commissioning

Figure 6 describes the activities performed by the CxA considering the transition between the design stage and the construction stage, until the first year of the operation of the building. The CxA carries out this process for each of the four LEED buildings that are part of the NAICM project.

Design	Constru	uction	Operation
Transition Meeting b	etween the Design and Construction S	tage	
Approval	of Submitals (Fact Sheets)		
	Site Visit		
	Incident Record		1
	Static Pre-functional Tests		1
	Adjustment a	nd Rolling Tests	
		Functional Dynamic Tests	
		Systems Manual	
	1	Training of Operations and Maintenance Staff	
	1	Commis	sioning Final Report
			Monitoring of the Main Systems and Visit at 10 months

Figure 6 - Timeline of activities during the design process

The activities of the CxA in this stage are sequential and all are fundamental to complete the commissioning process. However, the different tests performed to verify the functioning of the systems based on the objectives set in the design stage, allow identifying the status of the system in a comprehensive manner and determine if the goals proposed were achieved. The tests that must be implemented by the subcontractors of different specialties are described as follows:

Pre-functional static tests

These are static and independent assessments of each component and equipment that make the systems to verify that they comply with the minimum requirements established. The pre-functional tests have as an objective to prepare the systems to later do the functional tests. During the assessment, the CxA is in charge of developing the protocols of the pre-functional tests based on the constructive documents and standards. The process is done through a checklist that assesses visually only 20% of the components, while for the equipment, it includes the visual verification, installation and commissioning.

For the implementation of the tests, the CxA is responsible for training the contractors and subcontractors of each specialty so that they can do the tests without the supervision of the CxA. Once the subcontractor has captured the tests, the CxA will review and decide if the tests are acceptable.

Adjustments and Balancing Tests

In these tests, the subcontractor uses protocols set by the Commissioning Agent to adjust and balance the systems installed to keep the values specified in the constructive documents. Once the tests are finished, the subcontractor will send a report to the CxA for review.

Functional Dynamic Tests

In these tests, the functioning of the systems is assessed in an integrated way; that is, the behavior and performance of the components, equipment and controls. During the process, the operational modes and sequences to obtain the documented values in the BoD, are verified. The CxA is in charge of developing the protocols based on the BoD to define the modes and sequences to be tested, while the subcontractors of each specialty are in charge of performing the tests of each system or component installed. After getting the resolution of the functional tests, the CxA is in charge of documenting the status of the test.

4.4. Comparative Cases

The experience from different entities interested in the construction processes that intend to reach the energy efficiency standards, claim that the commissioning also benefits the projects in terms of cost-benefit. To explain cost-benefit, this report is based on the study "Commissioned Buildings", conducted by Mills (2009), which develops criteria to define the cost-benefit of the projects that have been commissioned. According to such study, the commissioning process is a good opportunity to save energy, money and greenhouse gas emissions, reaching almost twice the average level of savings and five times the savings of the projects without commissioning. Table 1 provides a summary of the characteristics of the sample taken from 409 commissioned projects and in 26 states within the United States of America. Among them, 332 were existing projects and 77 were new projects.

	Total	Existing	New
Characteristics			
Number of projects	409	332	77
Number of buildings	643	581	82
Number of states	26	21	15
Identified commissioning provides [1]	37	28	15
Commissioned floor area total (foot2)	99,224,809	90,410,884	8,813,925
Publics	71%	69%	85%
Private	29%	31%	15%
Investment			
Commissioning investment (USD\$2009) [2]			
Total proyect cost	43,484,002	28,582,970	14,921,031
(USD\$2009/project)		49,075	86,987
(USD\$2009/ft)		0.30	1.16
Cost as % of construction cost			0.4%
Outcomes			
Number of identified deficiencies [3]	10,108	6,652	3,528
Number of measures [3]	5,795	4,104	1,691
Energy saving			
Total primary energy		16%	13%
Payback time (years) [4]		1.1	4.2
Cost-benefit ratio [4]		4.5	1.1
Cash on cash return [4]		91%	23%
Cost of conserved carbon (\$tonnel) [4]		-110	-24

Table 1 - Sample of Characteristics, Outcomes and Investment

Made by Mills (2009)

Note: Statistics are median values. New values or ratios should not e computed by combining numbers in this table, as the simple sizes for which data are available vary by row.

[1] The provider is known for 55% of floor area treated in existing-building projects and 43% in the new-construction projects.

[2] Gross costs (excluding non-energy impacts).

[3] Systematically undercounted because some projects reported "Yes/No" rather than absolute counts. These tabulated as 0.999 for tallying purpose.

[4] Including non-energy impacts for projects where the information is available.

According to the research made by Mills, the payback time is 4.2 years for new projects and 1.1 years for existing projects. This means that the initial commissioning cost is 0.4% of the total cost of construction in new a project. In energy terms, the average of savings calculated from the commissioning process is 16% in existing projects and 13% in new projects. According to the study done by Mills (2009), the existing projects have higher energy savings because it is easier to identify and correct deficiencies during construction and design.

4.5. Retrocommissioning

Retro-commissioning is using the commissioning process within an existing building. This is a process that intends to improve the functioning of the equipment and systems as a whole. Depending on the age of the building, retro-commissioning can solve problems that occurred during the design or construction phases, or problems that have occurred during the life of the building. In summary, retro-commissioning improves the operation and maintenance procedures of a building to improve the functioning of the building. Retro-commissioning is very similar to On-going commissioning for new buildings which have followed a commissioning process since early design. On-going commissioning will be undertaken for NAICM.

By implementing this process in buildings that are already functional, a good parameter of the benefits derived from the use of a commissioning from the early stages of the life of the building is provided. It is estimated that this process has a cost that varies between \$.23/m2 and \$.8/m2 and the time of return of investment ranges between 0.2 to 2.1 years.

The main points it focuses on are:

- Improving the system operation.
- Improving the performance of equipment.
- Providing training to the operation and maintenance staff.
- Energy savings.
- Improving the quality of the interior environment of the building.
- Improving the documentation of the building.

Characteristics of low performance buildings:

- The bad operation or programming of the equipment and systems results in more energy consumption, which means higher costs.
- The unexpected repair or change of equipment affects the owners economically and in a direct manner, but this also affects the staff, since it hinders the activities.
- A bad air quality may cause diseases to users. This will cause absenteeism, thus, loses for the employers.

4.5.1. Benefits in Maintenance and Operation

On the other hand, if the process avoids fast solutions and addresses the root causes in order to consistently improve the building systems. Compared to the preventive maintenance practices that are focused on the reliability and capacity of equipment and components, retro-commissioning makes a comprehensive assessment of operations, control strategies, operation sequences and the way in which the mechanical equipment, lighting, the envelope of the building and the related controls, work together.

- Shows the Owner's needs and the project requirements at the forefront, in order to assure the resulting construction operations comply with the expectations.
- Improves the general performance of the building through the optimization of the energy efficiency and design characteristics, and directly addresses issues, like the performance of the system integration.
- Verifies that the construction staff members are properly trained and have the necessary documents to operate and maintain the building.
- Identifies potential environmental quality problems in interiors and eliminates complaints of the occupants.

Conclusions

- Commissioning is a process that assures the systems comply with the Owner requirements and the goals set during design, as well as strategies that extend these goals during the life of the building. Specifically, for the NAICM project, it is intended to reach an average of 50% savings in water and energy.
- Having commissioning helps mitigate impacts such as:
 - Systems losing balance in functioning over time due to variations in systems performance or set points drifts.
 - System affects due to changes in space uses and requirements for operational needs.
 - Repairs that are not well documented by technicians can affect the planned maintenance.
 - Inadequate control of air ventilation.
 - Increases in energy consumption.
 - Defective installation of equipment.
- Extends the life cycle of the equipment and systems, as well as guarantees its proper functioning and use.
- Proper training for the operation and maintenance technical staff.
- A comprehensive vision of the functioning of equipment and individual components increases their profitability and capacity.
- Efficient maintenance processes reduce the operation costs.

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5. Performance Indicators

Specific performance indicators are being developed for tracking through the on-going reporting in line with the Green Bonds framework.

5.1. Eligible Buildings

The Airport program is currently developing designs for LEED v4 ratings for the following buildings.

Building	LEED v4 Rating Target
Passenger Terminal Building	Platinum
Ground Transportation Center	Gold
Air Traffic Control Center	Gold
Area Control Center	Gold

In addition to the specific buildings undergoing the LEED rating process, there are impacts for other ancillary buildings and systems to achieve these targets.

The Central Utility Plants A & B (CUPs) are located in the West airfield and supply chilled water for cooling the Passenger Terminal Building (PTB) and Air Traffic Control Tower (ATCT), as well as facilities to the North within the Midfield area. The cooling systems are being designed to a high level of energy efficient performance.

The Ground Transportation Center will include a bus station and a metro rail station. A further bus station will be located to the North of the site for employees of the Midfield areas. Connectivity for the airport workers as well as passengers is critical for successful opening of the project and reducing car travel.

The project includes a dedicated Waste Water Treatment Plant. All black water from the initial phase of development will be treated to a high level to meet California Building Code requirements to provide a supply of treated water to airport buildings for lavatory flushing, irrigation and cleaning needs.

5.2. Energy and Water Consumption and Reduction Strategies

The MIA reviewed the currently observed values of water and energy consumption at the existing airport; based on these usages the new airport is targeting a reduction of around 70% in its use of potable water and 40% for energy usage.

All the buildings seeking a LEED rating are currently targeting a 50% energy cost reduction to meet the full points available. This 50% cost reduction is being designed through the following strategies:

- Implementation of Energy Conservation Measures (ECM's) within the building.
- Connection to a High Efficiency Campus Central Utility Plant.
- Power sourced from renewable energy sources.

Water consumption is being reduced through the following strategies:

- Dedicated on-site Waste Water Treatment Plant to provide a supply of treated water.
- Use of low flow fixtures for toilet flushing using treated water in buildings seeking a LEED rating.
- Use of low flow fixtures for lavatory fixtures using potable water in buildings seeking a LEED rating.

5.3. Greenhouse Gas Emissions

As laid out in the MIA the proposed building designs, boilers and power plants will reduce the Greenhous Gas emission by 50% compared to the current Mexico City Airport.

Reduction in Greenhouse Gas emissions aligns with the energy reduction strategies noted above for energy consumption.

Other opportunities which are being implemented or investigated at this time are as follows:

- Use of photovoltaic panels to provide site lighting and perimeter protection during construction.
- Provision of sufficient infrastructure to allow electric Ground Source Equipment (eGSE) for airlines and ground handlers to reduce non-aircraft airside air pollution.
- Identification of locations of natural resources and products to reduce pollution from transportation to the site.

5.4. Waste Reduction and Diversion from Landfill

LThe MIA outlines a range of reduction and recycling targets. Overall the new airport seeks a reduction of 10% to 30% in waste generation and an improvement of 10 to 30% in the amount to waste diverted to recycling facilities.

5.5. Energy Purchased or Generated On-site from Renewable Energies

The use of photovoltaics is currently being utilized for site lighting.

An extensive feasibility study is also currently in progress. This is to determine the best cost solution to meet the LEED demands of the project.