Handbook for Considering Practical Greenhouse Gas Emission Reduction Strategies for Airports

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ACRP REPORT 56

Handbook for Considering Practical Greenhouse Gas Emission Reduction Strategies for Airports

CDM
Cambridge, MA

IN PARTNERSHIP WITH

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Wareham, MA

TRANSPORTATION RESEARCH BOARD

AIRPORT COOPERATIVE RESEARCH PROGRAM

Airports are vital national resources. They serve a key role in transportation of people and goods and in regional, national, and international commerce. They are where the nation's aviation system connects with other modes of transportation and where federal responsibility for managing and regulating air traffic operations intersects with the role of state and local governments that own and operate most airports. Research is necessary to solve common operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the airport industry. The Airport Cooperative Research Program (ACRP) serves as one of the principal means by which the airport industry can develop innovative near-term solutions to meet demands placed on it.

The need for ACRP was identified in *TRB Special Report 272: Airport Research Needs: Cooperative Solutions* in 2003, based on a study sponsored by the Federal Aviation Administration (FAA). The ACRP carries out applied research on problems that are shared by airport operating agencies and are not being adequately addressed by existing federal research programs. It is modeled after the successful National Cooperative Highway Research Program and Transit Cooperative Research Program. The ACRP undertakes research and other technical activities in a variety of airport subject areas, including design, construction, maintenance, operations, safety, security, policy, planning, human resources, and administration. The ACRP provides a forum where airport operators can cooperatively address common operational problems.

The ACRP was authorized in December 2003 as part of the Vision 100-Century of Aviation Reauthorization Act. The primary participants in the ACRP are (1) an independent governing board, the ACRP Oversight Committee (AOC), appointed by the Secretary of the U.S. Department of Transportation with representation from airport operating agencies, other stakeholders, and relevant industry organizations such as the Airports Council International-North America (ACI-NA), the American Association of Airport Executives (AAAE), the National Association of State Aviation Officials (NASAO), and the Air Transport Association (ATA) as vital links to the airport community; (2) the TRB as program manager and secretariat for the governing board; and (3) the FAA as program sponsor. In October 2005, the FAA executed a contract with the National Academies formally initiating the program.

The ACRP benefits from the cooperation and participation of airport professionals, air carriers, shippers, state and local government officials, equipment and service suppliers, other airport users, and research organizations. Each of these participants has different interests and responsibilities, and each is an integral part of this cooperative research effort.

Research problem statements for the ACRP are solicited periodically but may be submitted to the TRB by anyone at any time. It is the responsibility of the AOC to formulate the research program by identifying the highest priority projects and defining funding levels and expected products.

Once selected, each ACRP project is assigned to an expert panel, appointed by the TRB. Panels include experienced practitioners and research specialists; heavy emphasis is placed on including airport professionals, the intended users of the research products. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, ACRP project panels serve voluntarily without compensation.

Primary emphasis is placed on disseminating ACRP results to the intended end-users of the research: airport operating agencies, service providers, and suppliers. The ACRP produces a series of research reports for use by airport operators, local agencies, the FAA, and other interested parties, and industry associations may arrange for workshops, training aids, field visits, and other activities to ensure that results are implemented by airport-industry practitioners.

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COOPERATIVE RESEARCH PROGRAMS

By Theresia H. Schatz
Staff Officer
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ACRP Report 56: Handbook for Considering Practical Greenhouse Gas Emission Reduction Strategies for Airports is a handbook and decision support tool that assists airport operators in identifying, evaluating, prioritizing, and implementing practical, low-cost strategies to reduce and manage greenhouse gas (GHG) emissions. The handbook and AirportGEAR, the interactive decision support tool developed in the research as a companion to the handbook, consider a range of strategies that can be implemented by all types of airports—regardless of size, geography, or resources—either directly or in partnership with airport stakeholders, including airlines, airport tenants, and host communities. A user's manual to guide the user through the decision support tool is also included. In addition, fact sheets, which are the foundation and data source for the tool and provide pertinent information to implement the reduction strategies, and a presentation, which provides awareness training materials that can be used by airports to educate and inform stakeholders, were developed. The decision support tool, the user's manual, the fact sheets, and the presentation are available on the attached CD-ROM. The user's manual is also printed in this report for ease of access.

There is increasing concern over aviation's contribution to greenhouse gas (GHG) emissions and associated environmental impacts affecting airports and the aviation industry. As environmental pressures continue to increase nationwide, it is imperative that airports take every opportunity to reduce their carbon footprint.

The report will assist airports, airlines, and airport tenants in reducing their GHG emissions by identifying practical, low-cost solutions and assisting them in better serving their passengers, customers, and host communities. This handbook and decision support tool identifies and evaluates best practices that airports can voluntarily implement.

Available resources were investigated and reviewed to gather information on proven and innovative measures for reducing airport-related GHG emissions. The research team documented the wide range of strategies for airport operators to reduce emissions of GHG associated with typical airport activity and compiled a list of 125 practices in 12 categories for use in the airport setting. The decision support tool was developed and field tested at a variety of airports of different sizes and geographic locations that provided suggested improvements.

A report documenting the research method used to develop the handbook, fact sheets, and decision support tool has been posted on the ACRP Project 02-10 web page of the TRB website (http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=2573).

CONTENTS

Handbook for Considering Practical Greenhouse Gas Emission Reduction Strategies for Airports

Airports are actively considering approaches to reduce airport-related greenhouse gas emissions. To assist airports with evaluating various strategies, this project analyzed various greenhouse gas emission reduction strategies and compiled a list of 125 practices for use in the airport setting. Technical information is presented for each strategy to assist airport operators with selection and implementation of the strategies that are most appropriate for a specific airport. The strategies can be used for airport-wide greenhouse gas emission reduction initiatives (e.g., minimizing the use of auxiliary power units) as well as to reduce greenhouse gas emissions associated with a specific project (e.g., installing energy efficient equipment as part of a building renovation). The research results can be used by airport employees in all departments, whether they are in the initial stages of learning about greenhouse gas mitigation or already have greenhouse gas emission reduction activities underway.

The research results include (1) this Handbook and (2) its accompanying decision-support tool, called AirportGEAR (*Airport Greenhouse Gas Emission Assessment and Reduction*). The information for 125 greenhouse gas reduction strategies is presented in Fact Sheets (one for each strategy) as Appendix A on the attached CD-ROM. This Handbook includes background information, descriptions of how the Fact Sheets were developed, and examples of how the Fact Sheets can be used to evaluate and select reduction strategies.

The information in the Fact Sheets and AirportGEAR can be used to serve many purposes, most of which fall into one of the following three categories:

- To gain familiarity with the types of strategies that are available
- To identify issues associated with a specific strategy
- To identify and select strategies that have the greatest ability to achieve a desired objective.

This research material includes strategies that may be within the authority of an individual user to control as well as those that users may only influence or for which users have no implementation control. Therefore, as users consider emission reduction strategies, they will need to understand issues of ownership and control of emission sources, emissions inventory boundaries, and other inventory accounting principles, which are reviewed in Section IV of this Handbook. *ACRP Report 11: Guidebook on Preparing Airport Greenhouse Gas Emissions Inventories* identifies the basic range of sources of greenhouse gas emissions at airports and approaches to preparing inventories. Most important in greenhouse gas inventories is the recognition of ownership of and control over the source in the inventory presentation. Therefore, emissions are characterized as Scope 1 (direct emissions), Scope 2 (indirect emissions), and Scope 3 (other emissions). Users of the Handbook and AirportGEAR should have a familiarity with how sources would be represented in an inventory, as discussed in Section IV of the Handbook. Depending on the scope of the emissions and the type of strategy, emission reduction strategies can be represented as a mitigation or an offset of GHG

emissions, which can affect the presentation of emissions in the inventory. As background, Section IV of the Handbook discusses the inventory process, mitigation versus offsetting, how emission reduction planning relates to other airport activities, and a summary of the current state of emissions regulation.

The Fact Sheets

A comprehensive literature review and interviews were conducted to identify 125 practical greenhouse gas emission reduction strategies and to compile technical information for each strategy that will assist airport operators in selecting and implementing the strategies. These strategies were systematically organized according to 12 categories, which effectively became a way of identifying the type of emission reduction strategies:

- Airfield Design and Operations (AF)
- Business Planning (BP)
- Construction (CN)
- Carbon Sequestration (CS)
- Energy Management (EM)
- Ground Service Equipment (GS)
- Ground Transportation (GT)
- Materials and Embedded Energy (ME)
- Operations and Maintenance (OM)
- Performance Measurement (PM)
- Renewable Energy (on-site) (RE)
- Refrigerants (RF)

Each reduction strategy was analyzed according to 11 evaluation criteria in order to consistently provide the user with important information about each strategy. The evaluation criteria are organized into three categories:

- **Financial Considerations**
  - Estimated capital costs
  - Estimated operation and maintenance costs
  - Estimated payback period
- **Implementation Considerations**
  - Implementation timeframe
  - Maturity of the reduction strategy
  - Airport control
- **Potential Impacts**
  - Greenhouse gas reduction potential (Scopes 1 and 2)
  - Greenhouse gas reduction potential (Scope 3)
  - Impacts to natural resources
  - Impacts to the built environment
  - Impacts to regulatory compliance

For each of the evaluation criteria, a visual icon, or rating value, is used to indicate the results of the analysis. For example, the strategies with the least expensive capital costs have a rating icon of one dollar sign ($) while those with the most expensive capital costs receive a rating icon of four dollar signs ($$$$). In addition, a narrative is provided that describes how the ratings were determined. For all evaluation criteria, the result of the analysis is based on published

information, airport interviews, vendor information, and/or institutional knowledge and professional judgment of the research team. The visual icons are presented in both the Fact Sheets and in AirportGEAR. The narratives are presented in the Fact Sheets, which are accessible on the attached CD-ROM in a PDF file as Appendix A and in AirportGEAR. The format and technical information included in the Fact Sheets is described in more detail in Section II.

AirportGEAR

AirportGEAR is an interactive electronic tool designed to assist airport operators in learning about and prioritizing and selecting the greenhouse gas emission reduction strategies that are most appropriate for a specific airport based on local information. AirportGEAR can be used by airport employees in all departments, whether they are in the initial stages of learning about greenhouse gas mitigation or already have greenhouse gas emission reduction activities under way. While the tool is based on the same technical information included in the Fact Sheets, AirportGEAR enables more active functions to analyze the information so that users can review, prioritize, and select strategies and create plans that meet their specific requirements and preferences for implementation. AirportGEAR is a self-contained application.

AirportGEAR includes six features to assist airport operators in evaluating, prioritizing, selecting, and planning for implementation of greenhouse gas emissions reduction strategies for facilities or projects. The ultimate product of using AirportGEAR is a written report, or series of reports, that includes the following:

- A list of the greenhouse gas reduction strategies selected by the user for a facility or project after evaluation and prioritization
- Key information about each of the selected strategies, such as greenhouse gas reduction potential, a numerical score calculated by AirportGEAR based on the rating values for the evaluation criteria, unit cost of carbon in dollars per metric ton of carbon dioxide equivalent reduced, and applicability to Scope 1 (direct), Scope 2 (indirect), and Scope 3 (other) emissions
- A comparison of the potential greenhouse gas emission reductions resulting from implementation of the strategies to an airport's baseline greenhouse gas inventory

The report(s) are intended to facilitate discussions about greenhouse gas mitigation and to assist in decision-making activities related to greenhouse gas reduction at specific facilities or for specific projects.

The features of AirportGEAR are designed to assist airport operators in reducing greenhouse gas emissions whether they are in the initial stages of learning about greenhouse gas mitigation or have a mature emission reduction program. Airport operators at different levels of progress in their greenhouse gas reduction activities will find different AirportGEAR features more useful to them depending on their current and planned activities. Guidance on using AirportGEAR based on different types of users is discussed in Section III.3 and in the AirportGEAR User's Manual, which is included as Appendix B of this Handbook.

The six major AirportGEAR features and their purposes are presented in Figure ES-1. In addition, the AirportGEAR features and their interactions with one another are presented in Figure ES-2.
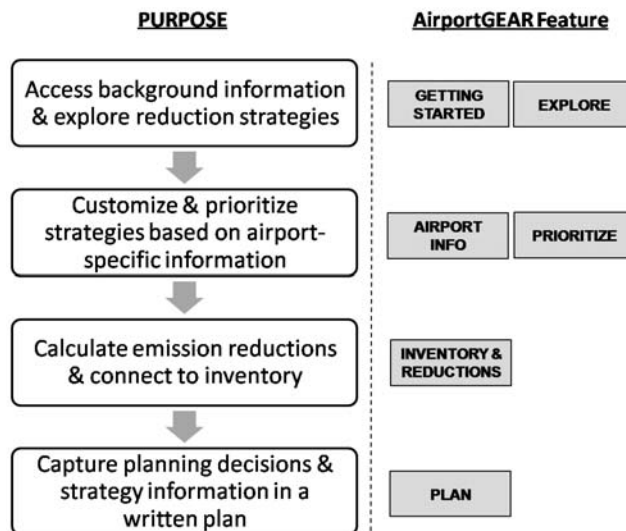
Figure ES-1.   AirportGEAR features and their purpose.

The following list describes the activities that are possible in the six major AirportGEAR features:

1. **GETTING STARTED:** Users can read through background information about the reduction strategies and how to use AirportGEAR to reduce greenhouse gas emissions.
2. **EXPLORE:** Users can browse, sort, filter, and search the 125 reduction strategies or access the LIBRARY of documents that contain background information. From **EXPLORE,** users can also select strategies for a facility or project and add them to a plan in the **PLAN** feature.
3. **PRIORITIZE:** Users can rank the evaluation criteria (e.g., cost) to prioritize the reduction strategies according to their needs and preferences. The custom prioritization of the evaluation criteria changes the numerical score calculated by AirportGEAR for each strategy, thus allowing users to see which strategies are most applicable to their facility or project (i.e., the strategies with the highest numerical scores are the most desirable). The numerical scores are presented in the LIST tab in **EXPLORE.**
4. **AIRPORT INFO:** Users can enter airport-specific information to determine which strategies are most applicable to their facility or project. The custom information entered by

Figure ES-2.   AirportGEAR features and their interactions with one another.

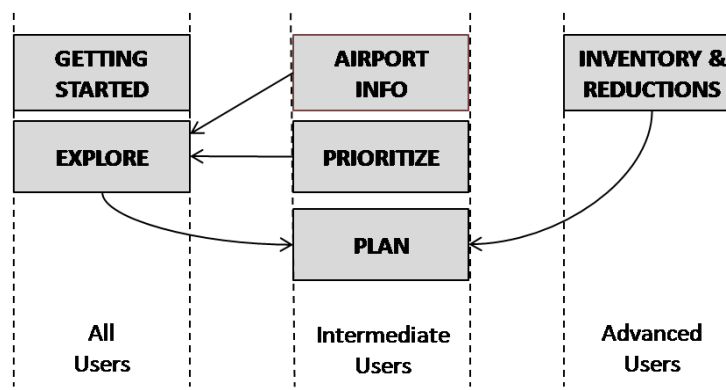   users is used to eliminate strategies that are not applicable to their airport. The strategies are eliminated from view in **EXPLORE.**

5. **PLAN:** Users can group strategies for a specific facility or project and store their choices in written reports.

6. **INVENTORY & REDUCTIONS:** Users can estimate potential emission reductions for each of the selected strategies and see how those reductions impact their greenhouse gas inventory. The comparison of their greenhouse gas inventory before and after implementation of the selected strategies is presented in the written reports that are organized in **PLAN.**

Key Messages

Upon completion of the research, several themes or key messages emerged that the research team felt were important to highlight to users of the results:

- **Varied Opportunities:** Various opportunities exist to reduce greenhouse gas emissions regardless of airport size, location, operating environment or resources. Strategies are available for all airports, whether they are in the initial stages of learning about greenhouse gas mitigation or already have greenhouse gas emission reduction activities under way. Greenhouse gas strategies can also be implemented by airport employees in all departments. This Handbook and AirportGEAR will assist an airport operator in selecting greenhouse gas reduction actions.
- **Greenhouse Gas Accounting Principles Are Critical:** Understanding greenhouse gas accounting principles and an airport's greenhouse gas inventory is imperative to selecting appropriate greenhouse gas reduction strategies. One size does not fit all.
- **Integrated Solutions:** Successful implementation of a greenhouse gas reduction program includes integration of reduction concepts into all departments and business processes in addition to discrete application of technological solutions in projects and stand-alone programs.
- **Life Cycle Emissions Are Important:** The results presented in this research do not reflect life cycle emissions associated with producing materials. Airports should be cognizant of life cycle emissions when looking at emission reduction strategies.

High-Priority Strategies

The research team and ACRP Project 02-10 panel recognized that high-priority strategies are those that give the "best bang for the buck." Tables ES-1 and ES-2 present the greenhouse gas reduction strategies that have relatively low estimated capital cost and relatively high greenhouse gas reduction potential; Tables ES-3 and ES-4 present those that have relatively fast payback periods and relatively high greenhouse gas reduction potential.

In addition, AirportGEAR calculates a numerical score for each greenhouse gas reduction strategy that is based on the results of the evaluation criteria (e.g., financial considerations, implementation considerations, and potential impacts). Table ES-5 presents the strategies in order of descending numerical scores in AirportGEAR. This list of strategies assumes that all evaluation criteria are weighted equally. To customize the list of prioritized strategies according to airport-specific information and preferences, weights can be added to the evaluation criteria in AirportGEAR, which would change the numerical scores.

Table ES-1.   Greenhouse gas reduction strategies with the lowest estimated capital cost and high emission reduction potential.

		Estimated Capital Cost
		< $10,000
		$
Greenhouse Gas Reduction Potential: Scopes 1 & 2		
Medium: There is potential for the reduction of Scopes 1 & 2 emissions to range from low to high depending on implementation details.		CS-04: Invest in Terrestrial Carbon Sinks EM-02: Specify Energy Efficient Requirements for Equipment in Contract Agreements EM-03: Develop Energy Performance Contracting Partnerships EM-09: Improve Insulation of Building Envelope EM-10: Change Set Points or Exclude Selected Zones from Heating and Cooling EM-18: Implement a Lighting System Energy Conservation Program EM-25: Install Evaporative Cooling Systems EM-29: Design for Larger Diameter Piping
High: Reduction of Scopes 1 & 2 emissions is always relatively high.		RF-02: Incorporate Intelligent Fault Diagnosis for HVAC Refrigerant Systems
Greenhouse Gas Reduction Potential: Scope 3		
Medium: There is potential for the reduction of Scope 3 emissions to range from low to high depending on implementation details.		AF-09: Implement Emission-Based Incentives and Landing Fees AF-12: Support Modernization of Air Traffic Management (ATM) AF-13: Support the Development of Alternative Fuels for Aircraft AF-14: Support Single/Reduced Engine Taxiing AF-16: Support Push Back Tugs to Transport Planes to Taxiways, Runway Ends and/or Take-off Areas CS-04: Invest in Terrestrial Carbon Sinks EM-02: Specify Energy Efficient Requirements for Equipment in Contract Agreements EM-03: Develop Energy Performance Contracting Partnerships EM-09: Improve Insulation of Building Envelope EM-10: Change Set Points or Exclude Selected Zones from Heating and Cooling EM-25: Install Evaporative Cooling Systems EM-29: Design for Larger Diameter Piping GS-01: Support Alternatively Fueled Ground Service Equipment (GSE) GT-02: Provide Preferential Car/Vanpool Parking for Employees GT-03: Promote Public Transit to the Airport GT-06: Alter Parking Pricing Structures for Employees and Passengers GT-15: Support Conversion of Tenant Fleet Vehicles to Alternatively Fueled Vehicles GT-16: Support Alternatively Fueled Vehicles for Rental Cars and Commercial Vehicles RF-02: Incorporate Intelligent Fault Diagnosis for HVAC Refrigerant Systems
High: Reduction of Scope 3 emissions is always relatively high.		None

Table ES-2.   Greenhouse gas reduction strategies with low estimated capital cost and high emission reduction potential.

		Estimated Capital Cost
		$10,000 - $100,000
		$$
Greenhouse Gas Reduction Potential: Scopes 1 & 2		
Medium: There is potential for the reduction of Scopes 1 & 2 emissions to range from low to high depending on implementation details.		BP-01: Use Greenhouse Gas Impact Evaluations as Decision-Making Criteria BP-02: Develop an Airport Expansion and Development Greenhouse Gas Emission Policy BP-03: Develop a Climate Action Plan (CAP) BP-08: Use Airport-Specific Sustainable Planning, Design and Construction Guidelines BP-09: Participate in a Greenhouse Gas Registry and/or Accreditation Program BP-10: Set a Policy for Green Building Certification for Buildings EM-08: Use Thermal Imaging to Identify Energy Losses EM-11: Restrict Heating and Cooling to Lowest 10 ft. of Indoor Space EM-14: Design Building Orientation for Energy Use Reduction EM-15: Apply Solar Reflective Paint EM-20: Periodically Recommission HVAC Systems and Control Systems EM-21: Install High-Efficiency Equipment and Controls EM-26: Install Energy Efficient Chillers EM-30: Reduce Transmission Losses in Electrical Wires EM-31: Purchase ENERGY STAR Equipment EM-32: Enhance Piping Insulation EM-37: Incorporate Use of Natural Ventilation and Economizer Control EM-38: Install Window Awnings or Sunshades EM-39: Utilize Sophisticated Energy Models for Building Design OM-01: Create a Detailed Operations and Maintenance Manual PM-01: Conduct Regular Greenhouse Gas (GHG) Emission Inventories RE-03: Install Solar Thermal Systems for Hot Water Production
High: Reduction of Scopes 1 & 2 emissions is always relatively high.		BP-05: Create a Carbon Offset Purchasing Strategy RF-01: Replace Refrigerants with Natural or Lower Global Warming Potential (GWP) Gases RF-04: Install Microchannel Components and Heat Exchangers
Greenhouse Gas Reduction Potential: Scope 3		
Medium: There is potential for the reduction of Scope 3 emissions to range from low to high depending on implementation details.		BP-01: Use Greenhouse Gas Impact Evaluations as Decision-Making Criteria BP-02: Develop an Airport Expansion and Development Greenhouse Gas Emission Policy BP-03: Develop a Climate Action Plan (CAP) BP-08: Use Airport-Specific Sustainable Planning, Design and Construction Guidelines BP-09: Participate in a Greenhouse Gas Registry and/or Accreditation Program BP-10: Set a Policy for Green Building Certification for Buildings AF-02: Minimize the Use of Auxiliary Power Units (APUs) CN-02: Recycle and Reuse Construction and Demolition Materials EM-08: Use Thermal Imaging to Identify Energy Losses EM-11: Restrict Heating and Cooling to Lowest 10 ft. of Indoor Space EM-14: Design Building Orientation for Energy Use Reduction EM-15: Apply Solar Reflective Paint EM-20: Periodically Recommission HVAC Systems and Control Systems EM-21: Install High-Efficiency Equipment and Controls EM-26: Install Energy Efficient Chillers EM-30: Reduce Transmission Losses in Electrical Wires EM-37: Incorporate Use of Natural Ventilation and Economizer Control EM-38: Install Window Awnings or Sunshades EM-39: Utilize Sophisticated Energy Models for Building Design GT-04: Provide Transit Fare Discounts and/or Alternative Mode Subsidies GT-16: Support Alternatively Fueled Vehicles for Rental Cars and Commerccial Vehicles PM-01: Conduct Regular Greenhouse Gas (GHG) Emission Inventories RE-03: Install Solar Thermal Systems for Hot Water Production RF-01: Replace Refrigerants with Natural or Lower Global Warming Potential (GWP) Gases RF-02: Incorporate Intelligent Fault Diagnosis for HVAC Refrigerant Systems RF-04: Install Microchannel Components and Heat Exchangers
High: Reduction of Scope 3 emissions is always relatively high		AF-11: Support Optimized Departure Management on Existing Runways BP-05: Create a Carbon Offset Purchasing Strategy

Table ES-3.   Greenhouse gas reduction strategies with the quickest payback period and high emission reduction potential.

		Estimated Payback Period
		< 2 years
Greenhouse Gas Reduction Potential: Scopes 1 & 2		
Medium: There is potential for the reduction of Scopes 1 & 2 emissions to range from low to high depending on implementation details.		BP-03: Develop a Climate Action Plan (CAP) EM-18: Implement a Lighting System Energy Conservation Program EM-31: Purchase ENERGY STAR Equipment
High: Reduction of Scopes 1 & 2 emissions is always relatively high.		RF-02: Incorporate Intelligent Fault Diagnosis for HVAC Refrigerant Systems
Greenhouse Gas Reduction Potential: Scope 3		
Medium: There is potential for the reduction of Scope 3 emissions to range from low to high depending on implementation details		BP-03: Develop a Climate Action Plan (CAP) RF-02: Incorporate Intelligent Fault Diagnosis for HVAC Refrigerant Systems
High: Reduction of Scope 3 emissions is always relatively high		None

Table ES-4.   Greenhouse gas reduction strategies with a quick payback period and high emission reduction potential.

		Estimated Payback Period
		2–5 years
Greenhouse Gas Reduction Potential: Scopes 1 & 2		
Medium: There is potential for the reduction of Scopes 1 & 2 emissions to range from low to high depending on implementation details.		EM-08: Use Thermal Imaging to Identify Energy Losses EM-09: Improve Insulation of Building Envelope EM-10: Change Set Points or Exclude Selected Zones from Heating and Cooling EM-14: Design Building Orientation for Energy Use Reduction EM-17: Install LED Runway and Taxiway Lighting EM-25: Install Evaporative Cooling Systems EM-30: Reduce Transmission Losses in Electrical Wires EM-37: Incorporate Use of Natural Ventilation and Economizer Control EM-38: Install Window Awnings or Sunshades EM-39: Utilize Sophisticated Energy Models for Building Design OM-01: Create a Detailed Operations and Maintenance Manual RE-06: Install Ground-Source or Geothermal Heating and Cooling System RE-08: Use Seawater and Natural Water Bodies for Cooling RE-12: Install Sewer Heat Recovery Systems RE-14: Utilize Local Landfill Gas
High: Reduction of Scopes 1 & 2 emissions is always relatively high.		EM-07: Evaluate Fuel Mix RF-01: Replace Refrigerants with Natural or Lower Global Warming Potential (GWP) Gases RF-04: Install Microchannel Components and Heat Exchangers
Greenhouse Gas Reduction Potential: Scope 3		
Medium: There is potential for the reduction of Scope 3 emissions to range from low to high depending on implementation details.		AF-07: Provide Fixed Gate Infrastructure for Aircraft Underground Supply and Evacuation Systems CN-02: Recycle and Reuse Construction and Demolition Materials EM-07: Evaluate Fuel Mix EM-08: Use Thermal Imaging to Identify Energy Losses EM-09: Improve Insulation of Building Envelope EM-10: Change Set Points or Exclude Selected Zones from Heating and Cooling EM-14: Design Building Orientation for Energy Use Reduction EM-25: Install Evaporative Cooling Systems EM-30: Reduce Transmission Losses in Electrical Wires EM-37: Incorporate Use of Natural Ventilation and Economizer Control EM-38: Install Window Awnings or Sunshades EM-39: Utilize Sophisticated Energy Models for Building Design RF-01: Replace Refrigerants with Natural or Lower Global Warming Potential (GWP) Gases RF-04: Install Microchannel Components and Heat Exchangers
High: Reduction of Scope 3 emissions is always relatively high.		None

Table ES-5. Greenhouse gas reduction strategies prioritized according to the numerical scores* calculated by AirportGEAR based on the evaluation criteria results.

Priority	Numerical Score*	Greenhouse Gas Reduction Strategy Name and Number	
1	81	RE-03	Install Solar Thermal Systems for Hot Water Production
2	81	EM-08	Use Thermal Imaging to Identify Energy Losses
3	81	EM-06	Develop and Market an Energy Conservation Program for Building Users
4	81	BP-03	Develop a Climate Action Plan (CAP)
5	81	RF-01	Replace Refrigerants with Natural or Lower Global Warming Potential (GWP) Gases
6	78	CS-04	Invest in Terrestrial Carbon Sinks
7	78	CN-03	Implement a Construction Vehicle Idling Plan
8	78	BP-08	Use Airport-Specific Sustainable Planning, Design, and Construction Guidelines
9	78	EM-18	Implement a Lighting System Energy Conservation Program
10	78	BP-10	Set a Policy for Green Building Certification for Buildings
11	78	EM-31	Purchase ENERGY STAR Equipment
12	78	EM-38	Install Window Awnings or Sunshades
13	78	EM-39	Utilize Sophisticated Energy Models for Building Design
14	75	EM-37	Incorporate Use of Natural Ventilation and Economizer Control
15	75	EM-10	Change Set Points or Exclude Selected Zones from Heating and Cooling
16	75	RF-02	Incorporate Intelligent Fault Diagnosis for HVAC Refrigerant Systems
17	75	RF-04	Install Microchannel Components and Heat Exchangers
18	72	GS-01	Support Alternatively Fueled Ground Service Equipment (GSE)
19	72	EM-01	Develop a Strategic Energy Management Plan
20	72	EM-07	Evaluate Fuel Mix
21	72	RE-01	Install Building Integrated Photovoltaic (BIPV) Panels
22	72	EM-24	Install Variable Speed Drives (VSD) and Optimize Controls of Pumps for Air Handling Units
23	72	EM-30	Reduce Transmission Losses in Electrical Wires
24	72	EM-03	Develop Energy Performance Contracting Partnerships
25	72	EM-25	Install Evaporative Cooling Systems
26	72	RE-14	Utilize Local Landfill Gas
27	72	EM-13	Install a Cool Roof
28	72	EM-14	Design Building Orientation for Energy Use Reduction
29	72	AF-12	Support Modernization of Air Traffic Management (ATM)
30	72	RE-12	Install Sewer Heat Recovery Systems
31	72	AF-17	Support Fuel Efficiency Targets for Aircraft
32	69	EM-21	Install High-Efficiency Equipment and Controls
33	69	EM-29	Design for Larger Diameter Piping
34	69	EM-17	Install LED Runway and Taxiway Lighting
35	69	EM-22	Integrate Thermal Storage into Heating and Cooling Systems
36	69	BP-05	Create a Carbon Offset Purchasing Strategy
37	69	RF-03	Use Hydronically Coupled Vapor-Compression Heat Pumps
38	69	EM-28	Install a Heat Recovery System
39	69	RE-13	Construct a Hydrogen Fueling and Generation Station
40	69	RE-02	Install Building-Mounted or Ground-Mounted Solar Photovoltaic (PV) Panels
41	69	CN-05	Specify Energy Efficient Temporary Lighting During Construction
42	69	CN-02	Recycle and Reuse Construction and Demolition Materials
43	69	OM-01	Create a Detailed Operations and Maintenance Manual
44	69	EM-09	Improve Insulation of Building Envelope
45	69	EM-02	Specify Energy Efficiency Requirements for Equipment in Contract Agreements
46	69	GT-15	Support Conversion of Tenant Fleet Vehicles to Alternatively Fueled Vehicles
47	67	GT-02	Provide Preferential Car/Vanpool Parking for Employees
48	67	AF-14	Support Single/Reduced Engine Taxiing
49	67	GT-17	Support Alternatively Fueled Taxis
50	67	GT-03	Promote Public Transit to the Airport
51	67	EM-11	Restrict Heating and Cooling to Lowest 10 ft of Indoor Space
52	67	EM-32	Enhance Piping Insulation

(continued)

Table ES-5.   (Continued).

Priority	Numerical Score*	Greenhouse Gas Reduction Strategy Name and Number	
53	67	AF-04	Design Runways, Taxiways, Ramps & Terminals to Reduce Aircraft Taxiing Distances
54	67	GT-16	Support Alternatively Fueled Vehicles for Rental Cars and Commercial Vehicles
55	67	GT-13	Promote Bicycle Use by Employees
56	67	GT-14	Convert Airport Fleet Vehicles to Alternatively Fueled Vehicles
57	67	EM-35	Install Energy Efficient Elevators, Escalators and Autowalks
58	67	BP-01	Use Greenhouse Gas Impact Evaluations as Decision-Making Criteria
59	67	EM-23	Evaluate and Upgrade the Central Plant and Distribution System Equipment
60	67	AF-18	Support the Use of Paperless Ticket Technology
61	67	BP-06	Develop and Apply or Sell Carbon Offsets
62	67	RE-09	Install Building-Mounted Wind Turbines
63	67	CN-01	Use Warm Mix Asphalt (WMA) in Place of Hot Mix Asphalt
64	67	EM-16	Apply Thermochromic Coatings on Buildings
65	67	EM-19	Install a Building Automation System (BAS)
66	67	EM-15	Apply Solar Reflective Paint
67	67	AF-09	Implement Emission-Based Incentives and Landing Fees
68	67	AF-11	Support Optimized Departure Management on Existing Runways
69	64	GT-10	Allow Flexible Work Schedules for Employees
70	64	PM-01	Conduct Regular Greenhouse Gas (GHG) Emission Inventories
71	64	ME-01	Develop an Integrated Solid Waste Management Plan
72	64	GT-01	Provide Priority Vehicle Parking for Emissions Friendly Vehicles
73	64	ME-04	Separate and Compost Food Waste
74	64	ME-02	Start or Enhance a Waste Reduction or Recycling Program
75	64	AF-02	Minimize the Use of Auxiliary Power Units (APUs)
76	64	BP-02	Develop an Airport Expansion and Development Greenhouse Gas Emission Policy
77	64	EM-12	Install Green Vegetated Roofs for Greater Building Insulation
78	64	CN-04	Specify Low-Emission Construction Vehicles and Equipment
79	64	AF-03	Design Airside Layout to Reduce Aircraft Delay and Surface Vehicle Congestion
80	64	EM-27	Install Ultraviolet-C (UVC) Lights in Air Handling Units (AHUs) for Continuous Coil Cleaning
81	64	CS-01	Install Sustainable, Long-Term Vegetation
82	64	GT-06	Alter Parking Pricing Structures for Employees and Passengers
83	61	AF-08	Create Partnerships with Intercity Rail Services to Optimize Passenger and Cargo Movement
84	61	BP-11	Support the Use of Customer Self-Service Equipment in Terminal Design
85	61	EM-20	Periodically Recommission HVAC Systems and Control Systems
86	61	OM-03	Use a Computerized Maintenance Management System (CMMS)
87	61	RE-07	Install a Geothermal Snow and Ice Melting System
88	61	EM-36	Optimize Passenger and Baggage Handling System
89	61	GT-07	Implement "On-foot" Payment for Parking
90	61	GT-08	Implement a Traffic Management System
91	58	RE-08	Use Seawater and Natural Water Bodies for Cooling
92	58	PM-02	Perform Energy Audits
93	58	GT-04	Provide Transit Fare Discounts and/or Alternative Mode Subsidies
94	58	GT-09	Allow Telecommuting for Employees
95	58	RE-04	Use Solar Desiccant Air Conditioning Systems
96	58	EM-26	Install Energy Efficient Chillers
97	58	OM-02	Develop a Measurement and Verification Plan
98	58	AF-16	Support Push Back Tugs to Transport Planes to Taxiways, Runway Ends and/or Take-off Areas

Table ES-5.   (Continued).

Priority	Numerical Score*	Greenhouse Gas Reduction Strategy Name and Number	
99	58	AF-07	Provide Fixed Gate Infrastructure for Aircraft Underground Supply and Evacuation Systems
100	53	AF-15	Support Alternative Passenger Boarding Procedures
101	53	BP-04	Develop Climate Change and Energy Communication Materials and/or Information Center
102	53	BP-09	Participate in a Greenhouse Gas Registry and/or Accreditation Program
103	53	AF-05	Consider Longer Runways to Reduce the Use of Reverse Thrust
104	53	AF-01	Provide Infrastructure for Pre-Conditioned Air (PCA) and Ground Power
105	53	PM-05	Work with Airport Industry to Develop Benchmarking Databases
106	53	ME-03	Start or Enhance a Green Procurement Program (GPP)
107	53	GT-12	Construct a Personal Rapid Transit (PRT) System
108	53	RE-06	Install Ground-Source or Geothermal Heating and Cooling System
109	50	PM-04	Track Energy Use
110	50	EM-04	Enter into a Green Power Purchasing Agreement
111	47	AF-13	Support the Development of Alternative Fuels for Aircraft
112	47	GT-05	Increase Mass Transit Access to the Airport
113	47	EM-05	Evaluate "Take or Pay" Contract Provisions
114	47	GT-11	Build a Consolidated Rent-A-Car Facility (ConRAC)
115	47	AF-06	Install or Expand Hydrant Fueling System
116	47	AF-10	Install a Jet Fuel Pipeline
117	47	RE-10	Install a Waste-to-Energy System
118	44	BP-07	Offer Voluntary Carbon Offsets for Passengers
119	44	PM-03	Install Tenant Energy Sub-Metering Systems
120	44	EM-34	Use Methane from Anaerobic Bioreactor Treatment Systems for Deicing Fluids
121	42	CS-02	Add Mineral Carbonation Systems to Exhaust Streams
122	42	RE-11	Install a Tidal Energy System
123	31	EM-33	Construct a Cogeneration or Trigeneration Energy System
124	28	CS-03	Implement or Support Carbon Dioxide Capture and Storage Processes
125	28	RE-05	Use On-site Biomass Energy Systems

* Numerical scores are normalized to be within 0 and 100 and consider all evaluation criteria to be weighted equally. Higher scores indicate more desirable strategies.

Introduction and Purpose of the Research

In embarking on this research, the oversight panel established the following purpose:

> Document the wide range of strategies available to airport operators to reduce emissions of greenhouse gases associated with typical airport activity.

The cornerstone of this project was the evaluation of various strategies for greenhouse gas emission reduction, presenting information in a manner that will assist users with understanding the effects of these strategies and in deciding which strategies are most appropriate for a specific airport. Two key work products were produced: (1) this Handbook and (2) its accompanying decision-support tool, called AirportGEAR (*Airport G*reenhouse Gas *E*mission *A*ssessment and *R*eduction). The information for the 125 greenhouse gas reduction strategies are presented in Fact Sheets (one for each strategy) as Appendix A on the attached CD-ROM. The Handbook includes background information useful in selecting greenhouse gas reduction strategies as well as information regarding how the Fact Sheets were developed and can be used to select reduction strategies. For AirportGEAR, the information from the Fact Sheets is presented in an electronic format that can be sorted and organized using an airport operator's local information and specific needs.

The Handbook and AirportGEAR each can be used as stand-alone products or they can be used together to enhance the usability of each product. While complex evaluations can be performed manually using information in the Fact Sheets and Handbook, AirportGEAR was designed to streamline review of the greenhouse gas reduction strategies and to assist airport operators in developing customized plans for reducing greenhouse emissions for a facility or a project. The Handbook also describes how AirportGEAR can be used to complement the material in this Handbook.

Airports across the country have varying levels of experience with many of the emission reduction strategies identified in this research, most of which are based on practical application. Therefore, both the Handbook and AirportGEAR were structured to provide as much meaningful information as possible to facilitate evaluation of the strategies, recognizing that every airport is different and has varying needs. The purpose of this Handbook and the AirportGEAR tool is to provide information about a wide range of emission reduction strategies so that airport operators and other parties can consider the benefits, costs, and other factors for implementing the strategies at any given location. The list of the 125 greenhouse gas emission reduction strategies resulting from this research is presented in Table I-1.

Table I-1.   List of practical greenhouse gas emission reduction strategies for airports.

Airfield Design and Operations	
AF-01	Provide Infrastructure for Pre-Conditioned Air (PCA) and Ground Power
AF-02	Minimize the Use of Auxiliary Power Units (APUs)
AF-03	Design Airside Layout to Reduce Aircraft Delay and Surface Vehicle Congestion
AF-04	Design Runways, Taxiways, Ramps & Terminals to Reduce Aircraft Taxiing Distances
AF-05	Consider Longer Runways to Reduce the Use of Reverse Thrust
AF-06	Install or Expand Hydrant Fueling System
AF-07	Provide Fixed Gate Infrastructure for Aircraft Underground Supply and Evacuation Systems
AF-08	Create Partnerships with Intercity Rail Services to Optimize Passenger and Cargo Movement
AF-09	Implement Emission-based Incentives and Landing Fees
AF-10	Install a Jet Fuel Pipeline
AF-11	Support Optimized Departure Management on Existing Runways
AF-12	Support Modernization of Air Traffic Management (ATM)
AF-13	Support the Development of Alternative Fuels for Aircraft
AF-14	Support Single/Reduced Engine Taxiing
AF-15	Support Alternative Passenger Boarding Procedures
AF-16	Support Push Back Tugs to Transport Planes to Taxiways, Runway Ends, and/or Take-off Areas
AF-17	Support Fuel Efficiency Targets for Aircraft
AF-18	Support the Use of Paperless Ticket Technology

Business Planning	
BP-01	Use Greenhouse Gas Impact Evaluations as Decision-Making Criteria
BP-02	Develop an Airport Expansion and Development Greenhouse Gas Emission Policy
BP-03	Develop a Climate Action Plan (CAP)
BP-04	Develop Climate Change and Energy Communication Materials and/or Information Center
BP-05	Create a Carbon Offset Purchasing Strategy
BP-06	Develop and Apply or Sell Carbon Offsets
BP-07	Offer Voluntary Carbon Offsets for Passengers
BP-08	Use Airport-Specific Sustainable Planning, Design, and Construction Guidelines
BP-09	Participate in a Greenhouse Gas Registry and/or Accreditation Program
BP-10	Set a Policy for Green Building Certification for Buildings
BP-11	Support the Use of Customer Self-Service Equipment in Terminal Design

Construction	
CN-01	Use Warm Mix Asphalt (WMA) in place of Hot Mix Asphalt
CN-02	Recycle and Reuse Construction and Demolition Materials
CN-03	Implement a Construction Vehicle Idling Plan
CN-04	Specify Low-emission Construction Vehicles and Equipment
CN-05	Specify Energy Efficient Temporary Lighting During Construction

Carbon Sequestration	
CS-01	Install Sustainable, Long-term Vegetation
CS-02	Add Mineral Carbonation Systems to Exhaust Streams
CS-03	Implement or Support Carbon Dioxide Capture and Storage Processes
CS-04	Invest in Terrestrial Carbon Sinks

Energy Management	
EM-01	Develop a Strategic Energy Management Plan
EM-02	Specify Energy Efficiency Requirements for Equipment in Contract Agreements
EM-03	Develop Energy Performance Contracting Partnerships
EM-04	Enter into a Green Power Purchasing Agreement

(continued)

Table I-1.   (Continued).

	Energy Management (cont.)
EM-05	Evaluate "Take or Pay" Contract Provisions
EM-06	Develop and Market an Energy Conservation Program for Building Users
EM-07	Evaluate Fuel Mix
EM-08	Use Thermal Imaging to Identify Energy Losses
EM-09	Improve Insulation of Building Envelope
EM-10	Change Set Points or Exclude Selected Zones from Heating and Cooling
EM-11	Restrict Heating and Cooling to Lowest 10 ft of Indoor Space
EM-12	Install Green Vegetated Roofs for Greater Building Insulation
EM-13	Install a Cool Roof
EM-14	Design Building Orientation for Energy Use Reduction
EM-15	Apply Solar Reflective Paint
EM-16	Apply Thermochromic Coatings on Buildings
EM-17	Install LED Runway and Taxiway Lighting
EM-18	Implement a Lighting System Energy Conservation Program
EM-19	Install a Building Automation System (BAS)
EM-20	Periodically Recommission HVAC Systems and Control Systems
EM-21	Install High-Efficiency Equipment and Controls
EM-22	Integrate Thermal Storage into Heating and Cooling Systems
EM-23	Evaluate and Upgrade the Central Plant and Distribution System Equipment
EM-24	Install Variable Speed Drives (VSD) and Optimize Controls of Pumps for Air Handling Units
EM-25	Install Evaporative Cooling Systems
EM-26	Install Energy Efficient Chillers
EM-27	Install Ultraviolet-C (UVC) Lights in Air Handling Units (AHUs) for Continuous Coil Cleaning
EM-28	Install a Heat Recovery System
EM-29	Design for Larger Diameter Piping
EM-30	Reduce Transmission Losses in Electrical Wires
EM-31	Purchase ENERGY STAR Equipment
EM-32	Enhance Piping Insulation
EM-33	Construct a Cogeneration or Trigeneration Energy System
EM-34	Use Methane from Anaerobic Bioreactor Treatment Systems for Deicing Fluids
EM-35	Install Energy Efficient Elevators, Escalators, and Autowalks
EM-36	Optimize Passenger and Baggage Handling System
EM-37	Incorporate Use of Natural Ventilation and Economizer Control
EM-38	Install Window Awnings or Sunshades
EM-39	Utilize Sophisticated Energy Models for Building Design

	Ground Service Equipment
GS-01	Support Alternatively Fueled Ground Service Equipment (GSE)

	Ground Transportation
GT-01	Provide Priority Vehicle Parking for Emissions Friendly Vehicles
GT-02	Provide Preferential Car/Vanpool Parking for Employees
GT-03	Promote Public Transit to the Airport
GT-04	Provide Transit Fare Discounts and/or Alternative Mode Subsidies
GT-05	Increase Mass Transit Access to the Airport
GT-06	Alter Parking Pricing Structures for Employees and Passengers
GT-07	Implement "On-foot" Payment for Parking
GT-08	Implement a Traffic Management System
GT-09	Allow Telecommuting for Employees

Table I-1.   (Continued).

Ground Transportation (cont.)	
GT-10	Allow Flexible Work Schedules for Employees
GT-11	Build a Consolidated Rent-A-Car Facility (ConRAC)
GT-12	Construct a Personal Rapid Transit (PRT) System
GT-13	Promote Bicycle Use by Employees
GT-14	Convert Airport Fleet Vehicles to Alternatively Fueled Vehicles
GT-15	Support Conversion of Tenant Fleet Vehicles to Alternatively Fueled Vehicles
GT-16	Support Alternatively Fueled Vehicles for Rental Cars and Commercial Vehicles
GT-17	Support Alternatively Fueled Taxis
Materials and Embedded Energy	
ME-01	Develop an Integrated Solid Waste Management Plan
ME-02	Start or Enhance a Waste Reduction or Recycling Program
ME-03	Start or Enhance a Green Procurement Program (GPP)
ME-04	Separate and Compost Food Waste
Operation and Maintenance	
OM-01	Create a Detailed Operations and Maintenance Manual
OM-02	Develop a Measurement and Verification Plan
OM-03	Use a Computerized Maintenance Management System (CMMS)
Performance Measurement	
PM-01	Conduct Regular Greenhouse Gas (GHG) Emission Inventories
PM-02	Perform Energy Audits
PM-03	Install Tenant Energy Sub-Metering Systems
PM-04	Track Energy Use
PM-05	Work with Airport Industry to Develop Benchmarking Databases
Renewable Energy (on-site)	
RE-01	Install Building Integrated Photovoltaic (BIPV) Panels
RE-02	Install Building-mounted or Ground-mounted Solar Photovoltaic (PV) Panels
RE-03	Install Solar Thermal Systems for Hot Water Production
RE-04	Use Solar Desiccant Air Conditioning Systems
RE-05	Use On-site Biomass Energy Systems
RE-06	Install Ground-Source or Geothermal Heating and Cooling System
RE-07	Install a Geothermal Snow and Ice Melting System
RE-08	Use Seawater and Natural Water Bodies for Cooling
RE-09	Install Building-Mounted Wind Turbines
RE-10	Install a Waste-to-Energy System
RE-11	Install a Tidal Energy System
RE-12	Install Sewer Heat Recovery Systems
RE-13	Construct a Hydrogen Fueling and Generation Station
RE-14	Utilize Local Landfill Gas
Refrigerants	
RF-01	Replace Refrigerants with Natural or Lower Global Warming Potential (GWP) Gases
RF-02	Incorporate Intelligent Fault Diagnosis for HVAC Refrigerant Systems
RF-03	Use Hydronically Coupled Vapor-Compression Heat Pumps
RF-04	Install Microchannel Components and Heat Exchangers

Development of the Fact Sheets

The foundation of the Handbook and AirportGEAR is the technical information for each of the 125 greenhouse gas emission reduction strategies. The technical information is organized and presented in a four-page Fact Sheet for each strategy (See Appendix A on the attached CD-ROM). In developing the Fact Sheets, the emission reduction strategies were categorized and evaluated relative to a number of attributes:

- Category of the strategy—such as business planning, ground transportation;
- Evaluation criteria—representing issues likely of interest or concern to airports;
- Other relevant information—including favorable implementation areas, geographic regions, and airport sizes; and
- Ranking guidance—variables that users can use to help identify strategies that would meet their needs.

This section of the Handbook describes the Fact Sheets and provides details about these attributes.

II.1 Strategy Categories

A comprehensive literature review and airport interviews were conducted to initiate the data-gathering activities for this project. The reduction strategies derived from the literature and interviews were systematically organized according to the set of subject categories presented in Table II-1, which effectively became a way of identifying the type of emission reduction measures. A picture is designated for each strategy category to assist in the navigation of the Fact Sheets.

In addition to the literature review and interviews, Internet resources were investigated to collect technical information. Information sources included the airport trade associations [American Association of Airport Executives (AAAE), Airports Council International (ACI), Airport Consultants Council (ACC), and International Civil Aviation Organization (ICAO)], airport users [Air Transport Association (ATA)], federal agencies (USEPA and USDOT), and California Climate Action Registry (CCAR). Pertinent research from the Transportation Research Board (TRB) was also included in the information gathering. A complete list of references is included on the attached CD-ROM.

Table II-1.　Categories of greenhouse gas emission reduction strategies.
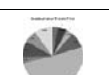
Picture for Category	Category	Category Abbreviation	Number of Strategies	Coverage
	Airfield Design and Operations	AF	18	Strategies that directly address emissions associated with airfield design and aircraft operations
	Business Planning	BP	11	Airport administrative strategies designed to aid in emission reduction
	Construction	CN	5	Construction process emission reduction strategies
	Carbon Sequestration	CS	4	Strategies designed to capture carbon dioxide from the atmosphere and provide long-term storage
	Energy Management	EM	39	Strategies designed to reduce facility energy consumption and provide alternative energy supplies
	Ground Service Equipment	GS	1	Strategies designed to reduce emissions from vehicles that support aircraft and airport maintenance
	Ground Transportation	GT	17	Strategies associated with the movement of passengers, employees, and goods/services to and from the airport
	Materials and Embedded Energy	ME	4	Strategies associated with procurement and waste streams
	Operations and Maintenance	OM	3	Strategies designed to address the operation and maintenance of airport facilities
	Performance Measurement	PM	5	Strategies designed to evaluate performance of emission reduction plans and actions
	Renewable Energy (on-site)	RE	14	Strategies to generate various forms of renewable energy (sun, wind, geothermal, gas, etc).
	Refrigerants	RF	4	Strategies designed to address refrigerant use at airports and the associated greenhouse gases

Photo sources: GT – Los Angeles World Airports; PM – Adapted from *ACRP Report 11*; RE – Denver International Airport; BP, CS, CN, EM, ME, and OM – Office.Microsoft.com Media Gallery © Microsoft.

II.2　Evaluation Criteria

Each reduction strategy was evaluated in accordance with eleven analysis criteria in three categories:

- **Financial Considerations**
  – Estimated capital cost
  – Estimated operation and maintenance (O&M) costs
  – Estimated payback period
- **Implementation Considerations**
  – Implementation timeframe
  – Maturity of the reduction strategy
  – Airport control

- **Potential Impacts**
  - Greenhouse gas reduction potential (Scopes 1 and 2)
  - Greenhouse gas reduction potential (Scope 3)
  - Natural resources
  - Built environment
  - Regulatory compliance

For each of the evaluation criteria, a visual icon, or rating value, is used to indicate the results of the analysis. For example, the strategies with the least expensive capital costs have a rating icon of one dollar sign ($) while those with the most expensive capital costs receive a rating icon of four dollar signs ($$$$). In addition, a narrative is provided that describes how the ratings were determined. For all evaluation criteria, the result of the analysis is based on published information, airport interviews, vendor information, and/or institutional knowledge and professional judgment of the research team. The visual icons are presented in both the Fact Sheets and in AirportGEAR. The narratives are presented in the Fact Sheets, which are accessible on the attached CD-ROM as Appendix A and in AirportGEAR. The format of and technical information included in the Fact Sheets is described in more detail in the remainder of Section II.

The following subsections briefly summarize the methodologies used to evaluate these criteria. A summary of the evaluation criteria and the rating values is presented in Table II-2 at the end of this section (page 23); users may wish to print it to have handy as they review the Fact Sheets or use AirportGEAR.

II.2.1 Financial Considerations

When considering emission reduction strategies, users are likely to have questions concerning the financial costs. The research team identified several variables that would be of interest to the user when addressing these financial considerations:

- What is the capital cost to initiate the strategy (i.e., build and install)?
- What are the ongoing costs to operate and maintain the strategy (O&M costs)?
- What is the payback, if any, with the strategy? For instance, if the strategy results in an energy savings, how long will it take to recover the capital costs?

The evaluation of each strategy identifies high-level values for capital cost, O&M cost, and payback period. For example, the capital cost criteria identified whether a reduction strategy will initially cost less than $10,000, between $10,000 and $100,000, between $100,001 and $1,000,000, or greater than $1,000,000.

Estimated Capital Cost

The estimated capital cost reflects the estimated upfront costs to plan, design, and/or construct the reduction strategy. This estimate includes both soft costs (labor for design and planning) as well as equipment costs, if necessary. The estimated capital cost does not include the use of grants or funding to pay for the initial costs. It does also not include the cost of carbon. The estimated capital cost rating value is based on published information, airport interviews, vendor information, and/or the institutional knowledge and professional judgment of the research team. Dollar sign icons are used to reflect the following ranges:

$	< $10,000
$$	$10,000–$100,000
$$$	$100,001–$1,000,000
$$$$	> $1,000,000

Estimated O&M Costs

Estimated O&M costs reflect estimated annual operations and maintenance costs, which would include labor and material costs necessary to implement the action. The estimated O&M cost rating value is based on published information, airport interviews, vendor information, and/or the institutional knowledge and professional judgment of the research team. Wrench icons are used to reflect the following ranges:

< $5,000

$5,000–$50,000

$50,001–$100,000

> $100,000

Estimated Payback Period

The estimated payback metric provides a general indication of how long the energy savings (if any) will pay for the capital and O&M costs and does not include the use of grants or funding. It also does not include the cost of carbon. The estimated payback period rating value is based on published information, airport interviews, vendor information, and/or the institutional knowledge and professional judgment of the research team. Calendar icons are used to reflect the following ranges:

< 2 years

2–5 years

6–10 years

> 10 years

II.2.2 Implementation Considerations

As users consider various strategies, a number of implementation considerations often influence an airport's desire and/or ability to adopt a strategy:

- Is the strategy under the direct control of the airport operator, or what degree of control and authority would most airport operators have over the strategy's implementation?
- What is the length of time necessary to plan and implement the strategy?
- Is the strategy proven or new in its use in the airport setting?

The evaluation of each strategy identifies where the strategy falls in the range of possibilities for each of these criteria.

Implementation Timeframe

This metric represents how long it will take the user to plan/design/build the reduction strategy and get it running so that greenhouse gas emissions are being reduced. Clock icons are used to reflect the following timeframes:

Immediate: < 1 year

Short-term: 1–5 years

Medium-term: 5–10 years

Long-term: > 10 years

Maturity of Reduction Strategy

This metric indicates whether the strategy is a proven approach that is implemented by many airport organizations or one that is cutting edge and only implemented by a few organizations (and hence a little bit riskier). A single star indicates less mature (i.e., in the concept stage) strategies and may represent greater risk, whereas the four-star strategies are in wider use, better understood, and proven. This rating value is based on programs that are currently in place at airports and in other industries as well as on professional judgment. The stars indicate the following scale:

★	Conceptual stage
★★	Trial tested
★★★	Proven
★★★★	Proven at airports

Airport Control

This evaluation criterion is another way of noting the airport operator's role and thus ability to control the strategy and associated emissions. The rating indicates typical airport conditions (e.g., the airport operator typically does not control pre-conditioned air systems); however, the research team acknowledges that actual control may vary depending on the operating environment at the airport. The plane icons indicate the authority/control that the airport operator would have over implementation of the strategy:

✈	Airport operator has no ownership, control, or influence over implementation of the strategy.
✈ ✈	Airport operator has no ownership or control but can influence the reduction of greenhouse gas emissions through policy, procedures, or training.
✈ ✈ ✈	Airport has no ownership or control but can influence the reduction of greenhouse gas emissions through infrastructure improvements.
✈ ✈ ✈ ✈	Airport operator has complete control over implementation of the strategy.

II.2.3 Potential Impacts

One of the fundamental needs of many users will be to better understand the local consequences of individual emission reduction strategies. Research focused on addressing the following questions about each strategy, which were then included in the Potential Impacts category:

- What will be the estimated emission reduction from implementation of the strategy?
- Will the strategy create direct or indirect effects on natural resources or require the depletion of natural resources locally?
- Will the strategy create direct or indirect effects on the built environment (such as noise, light emissions, odor, etc.)?
- Are there any regulatory-related issues that must be considered with the strategy?

For the evaluation of emission reduction potential, the magnitude of the potential reduction of Scopes 1 and 2 emissions is presented combined and that of Scope 3 emissions is presented separately. The magnitude of potential reduction is considered low (i.e., emission reduction always relatively low), medium (i.e., potential varies between low and high, depending on the specific implementation details), or high (emission reduction always relatively high). For impacts to natural resources, the built environment, and regulatory compliance, the rating scale indicates whether there will be negative impacts or positive benefits associated with the reduction strategy.

Greenhouse Gas Reduction Potential, Scopes 1 & 2

The airport is responsible for the sources of Scopes 1 & 2 emissions; see Section IV for a description of greenhouse gas accounting principles. The metric was defined based on the World Resources Institute (WRI) classifications and the professional judgment of the research team concerning the degree of effect on the emissions. The icons represent the following ratings:

None   Does not decrease Scopes 1 & 2 emissions

    Low: Reduction of Scopes 1 & 2 emissions is always relatively low.

    Medium: There is potential for the reduction of Scopes 1 & 2 emissions to range from low to high depending on implementation details.

    High: Reduction of Scopes 1 & 2 emissions is always relatively high.

Greenhouse Gas Reduction Potential, Scope 3

The sources for Scope 3 emissions are the responsibility of either the tenant or the public; see Section IV of this Handbook for a description of greenhouse gas accounting principles. The metric was defined based on the WRI classifications and the professional judgment of the research team concerning the degree of effect on the emissions. Using the same descriptions as for Scopes 1 & 2, the icons represent the following ratings:

None   Does not decrease Scope 3 emissions.

    Low: Reduction of Scope 3 emissions is always relatively low.

    Medium: There is potential for the reduction of Scope 3 emissions to range from low to high depending on implementation details.

    High: Reduction of Scope 3 emissions is always relatively high.

Impacts to Natural Resources

This evaluation criterion indicates when the effect of the strategy on natural resources (criteria pollutant air emissions, surface water, groundwater, sediment, wetlands, floodplains, undeveloped lands, etc.) is to increase or decrease the their depletion (e.g., additional make-up water may be needed for a recommended building cooling technology). A thumb-down indicates adverse effect, whereas a thumb-up represents beneficial impact based on professional judgment:

    Adverse impact to natural resources (i.e., increases stormwater runoff)

    No benefit or impact to natural resources

    Benefit to natural resources (i.e., reduces criteria pollutants)

Impacts to the Built Environment

This criterion indicates the negative or positive effect of the strategy on the human environment of the surrounding communities (e.g., noise from an airfield design, increased road traffic for biomass deliveries, etc.). In general, there will be a strong correlation between impacts to natural resources and impacts to the built environment because the actual impacts

may overlap (e.g., degradation of air quality). Using professional judgment, the following ratings were used:

 Adverse impact to the built environment (e.g., increases noise)

 No adverse or positive impact to the built environment

 Positive impact to the built environment (e.g., social benefits)

Impacts to Regulatory Compliance

This criterion indicates degree of difficulty in complying with state and federal airport and environmental regulations. Using professional judgment, the following ratings were used:

 May trigger a change to regulatory compliance status

 Does not change regulatory compliance status

 May facilitate compliance with a regulation

Table II-2.   Evaluation criteria for strategies.

Financial Considerations		
Criterion	**Definition**	**Ranking Scale**
Estimated Capital Costs	Upfront costs to plan, design and/or construct the reduction action.	$ < $10,000
		$$ $10,000–$100,000
		$$$ $100,001–$1,000,000
		$$$$ > $1,000,000
Estimated Annual Operations and Maintenance Costs	Annual costs for continued implementation of the reduction action.	< $5,000
		$5,000–$50,000
		$50,001–$100,000
		> $100,000
Estimated Payback Period*	The time required for the return on an investment to "repay" the capital and operations and maintenance costs.	< 2 years
		2–5 years
		6–10 years
		> 10 years

(continued)

Table II-2.   (Continued).

Implementation Considerations		
Criterion	*Definition*	*Ranking Scale*
Airport Control**	The level of financial and logistical control of the airport operator to implement the reduction action.	✈ — Airport operator has no ownership, control, or influence over implementation of the strategy.
		✈✈ — Airport operator has no ownership or control but can influence the reduction of GHG emissions through policy, procedures, or training.
		✈✈✈ — Airport has no ownership or control but can influence the reduction of GHG emissions through infrastructure improvements.
		✈✈✈✈ — Airport operator has complete control over implementation of strategy.
Implementation Timeframe	The time period required to implement the action and reduce GHG emissions.	🕐 — Immediate: < 1 yr
		🕐🕐 — Short term: 1–5 yrs
		🕐🕐🕐 — Medium term: 5–10 yrs
		🕐🕐🕐🕐 — Long term: > 10 yrs
Maturity of Reduction Strategy	Past demonstration that the reduction action is implementable and effective.	★ — Conceptual stage
		★★ — Trial tested
		★★★ — Proven
		★★★★ — Proven at airports

(continued)

II.3 Fact Sheet Organization

The results of the analysis of the reduction strategies are presented in a Fact Sheet for each strategy included in Appendix A. The information on the four-page Fact Sheets is explained in the following subsections.

II.3.1 Page 1, Strategy Description

Reduction Action Description

A description of each strategy is provided, including first steps that are needed for implementation. These descriptions are comprehensive but also concise. To avoid duplication of material in other portions of the Fact Sheet, it only describes the basic characteristics of the strategy, not including cost, impact, or emission reduction.

Quick-Scan Interpretative Icons

A low number of bolded icons indicates low impact/cost, whereas, a high number of bolded icons indicates high impact/cost. The bolded icons reflect current conditions, results of case studies, and personal experience of the research team. The evaluation criteria are defined in Section II.2.

II.3.2 Page 2, Details of Evaluation Criteria Results

This page of the Fact Sheet presents how the results of applying the evaluation criteria were determined. To avoid continuous page flipping, the symbols from the preceding page are repeated on the left column of page 2.

Table II-2.   (Continued).

Potential Impacts		
Criterion	*Definition*	*Ranking Scale*
GHG Reduction Potential: *Scopes 1 & 2***	The magnitude of the reduction in Scopes 1 & 2 GHG emissions (direct and indirect emissions) as a result of the action.	*None* — Does not decrease Scopes 1 &2 emissions
		Low: Reduction of Scopes 1 & 2 emissions is always relatively low.
		Medium: There is potential for the reduction of Scopes 1 & 2 emissions to range from low to high depending on implementation details.
		High: Reduction of Scopes 1 & 2 emissions is always relatively high.
GHG Reduction Potential: *Scope 3***	The magnitude of the reduction in Scope 3 GHG emissions (other emissions) as a result of the action.	*None* — Does not decrease Scope 3 emissions
		Low: Reduction of Scope 3 emissions is always relatively low.
		Medium: There is potential for the reduction of Scope 3 emissions to range from low to high depending on implementation details.
		High: Reduction of Scope 3 emissions is always relatively high.
Impacts to Natural Resources	Impacts or secondary benefits to natural resources.	Adverse impacts to natural resources (i.e., stormwater)
		No benefit or impact to natural resources
		Benefit to natural resources (i.e., reduces criteria pollutants)
Impacts to the Built Environment	Impacts or secondary benefits for the built environment and local communities.	Adverse impacts to the built environment (e.g., increases noise)
		No adverse or positive impacts to the built environment
		Positive impact to the built environment (e.g., social benefits)
Impacts to Regulatory Compliance	Impact on the airport operator's compliance status with regulations.	May trigger a change to regulatory compliance status
		Does not change regulatory compliance status
		May facilitate compliance with a regulation

* Does not consider financial incentives such as grants, rebates or tax incentives
** Ranking scale is representative of a majority of airports, but may not fit the control and operation structure for every airport.

Financial Considerations

This section provides the details that went into determining the financial considerations ratings used on pages 1 and 2 (i.e., estimated capital costs, O&M costs, and payback period) as well as any additional information that may be needed to plan for the financial implications of implementing the reduction strategy. For example, this text may discuss strategies involving third-party agreements [e.g., Energy Service Companies (ESCOs)], cost-sharing strategies with airlines, potential revenue streams from Renewable Energy Credits (RECs), carbon offsets or sale of electricity, or other indirect costs or financial benefits that may be associated with the reduction measure. Other business/financial planning strategies, such as creating a revolving fund using savings that will finance additional reduction strategies, are also noted.

Implementation Considerations

This section explains how the ratings were determined for the criteria of airport control, implementation timeframe, and maturity of the reduction strategy. Additional information that is critical for the user to understand the process of implementing the strategy is also included.

Potential Impacts

This section explains how the ratings were determined for the potential impacts evaluation criteria (i.e., greenhouse gas reduction potential and impacts to natural resources, the built environment, and regulatory compliance) as well as any other additional information that is critical for the user to understand during decision-making activities.

Quick-Scan Interpretative Icons

This section repeats the page 1 icons for financial and implementation considerations and potential impacts.

II.3.3 Page 3, Attributes

This page presents various characteristics of the strategy in a format that enables the user to scan the sections to determine whether the strategy may be applicable or desirable to the user.

Potential Limitations

This narrative identifies potential obstacles to implementation that may be encountered. For example, certain technologies may either compete with each other or decrease the efficiency of other reduction strategies. In addition, a reduction measure may increase Scope 1 emissions (e.g., cogeneration) while reducing Scope 2 emissions. Risks are also outlined (e.g., ice and snow sliding off of solar panels onto pedestrians, etc.).

Reduction Action Affects GHG Sources (by Owning/Controlling Entity)

Review of this section of the Fact Sheet will enable users to narrow their search to strategies affecting specific sources. See Section IV of the Handbook for a description of sources.

Favorable Geographic Regions

This section identifies the practicality of strategies based on geographic location of an airport. Ten regions were used:

- **Alaska**
- **Central West Coast:** Central and Northern California and Nevada
- **Hawaii** and Guam
- **Lower Midwest:** Texas, Oklahoma, Kansas, Missouri, and Arkansas
- **Mid Atlantic:** New York, New Jersey, Pennsylvania, Maryland, Delaware, West Virginia, Virginia, and the District of Columbia
- **Northeast:** Maine, Vermont, New Hampshire, Massachusetts, Connecticut, and Rhode Island
- **Northwest:** Washington, Oregon, Idaho, Montana, and Wyoming
- **Southeast:** Louisiana, Mississippi, Alabama, Florida, Georgia, South Carolina, North Carolina, Tennessee, and the territories of Puerto Rico and the Virgin Islands
- **Southwest:** Southern California, Utah, Colorado, Arizona, and New Mexico
- **Upper Midwest:** Michigan, Ohio, Kentucky, Indiana, Illinois, Wisconsin, Minnesota, Iowa, North Dakota, South Dakota, and Nebraska

Favorable Airport Sizes

This section identifies the practicality of strategies based on airport size. For example, Jetway-based pre-conditioned air may not be applicable at airports that do not have commercial service and Jetways. Airport sizes are categorized based on levels of activity:

- **Large hub:** airports representing 1% or more of total US passenger enplanements (passengers boarding commercial service aircraft); consists of about 30 airports
- **Medium hub:** airports representing at least 0.25% (and less than 1%) of total US passenger enplanements; consists of about 37 airports
- **Small hub:** airports representing at least 0.5% (but less than 0.25%) of total US passenger enplanements; consists of about 72 airports
- **Non-hub:** airports representing at least 2,500 enplaned passengers; consists of about 378 airports
- **General aviation:** all other airports; consists of nearly 2,900 airports

Recommended Stakeholder Engagement

In general, comprehensive stakeholder engagement is recommended to enhance the success of the implementation of a greenhouse gas reduction measure, as noted in Section IV. The "Other Industries" category includes industry stakeholders (vendors, manufacturers, trade organizations) that would enhance implementation. Eleven groups of stakeholders are noted and multiple groups may apply to an individual strategy:

- Airlines/aircraft operators
- Airport personnel
- Community groups
- FAA
- Local businesses (e.g., solar panel manufacturers)
- Local government (e.g., city council)
- Non-governmental organizations (NGOs)
- Non-FAA Regulators (e.g., state environmental regulators)
- Regional entities (e.g., regional transportation authorities)
- Tenants (reflecting non-aircraft operator tenants)
- Utilities (electrical, gas, oil, etc.)

Space Requirements

Because many airports are space constrained, the user may want to consider possible space issues. This section notes the amount of space the strategy needs:

- No space required
- Small (less than 1 acre)
- Significant (greater than 1 acre)

Project Type

This section provides information concerning the phase/department in which the reduction strategy should be initiated and carried out. This information is critical for resource allocation and proper planning for implementation (i.e., construction recycling needs to be considered during design so that appropriate specifications can be included in the bid package). Six options are provided (note that multiple options may apply):

- Planning
- Design

- Construction
- Airside Operations
- Landside Operations
- Administrative

Functional Area

This section denotes which areas of the airport may be directly involved or impacted during implementation. More than one of the possible 16 Implementation Areas may be checked [these areas are consistent with those identified in the resources published by the Sustainable Aviation Guidance Alliance (SAGA)]:

- **Airport Building Facilities:** passenger terminals (and may be redundant with the "Terminal Areas Indoor" area) for larger airports or the administrative building for general aviation airports. Included are all non-tenant support structures, such as maintenance buildings, operations centers, snow sheds, etc.
- **Airfield:** runways and taxiways
- **Baggage Handling:** baggage makeup and delivery area within the indoor and outdoor terminal areas
- **Cargo Warehousing:** all buildings associated with mail, freight, and belly-cargo and the freight forwarder area
- **Control Tower:** the air traffic control tower, terminal radar approach control, enroute control facility, and ground control movement centers
- **Fueling Stations:** all stations where on-airport fueling occurs, e.g., fuel farms, truck racks, fueling pumps
- **Navigation Aids:** Any form of aid-to-air navigation on an airport
- **Parking:** parking for ground vehicles, which may include public, employee, and tenant parking
- **Public Transportation Facilities:** facilities that enable the transfer of passengers from the airport to areas within the local community; typically consist of bus, light rail, heavy rail, etc.
- **Rental Car Facilities:** facilities associated with private companies that rent ground vehicles to passengers using the airport; includes space in the passenger terminals as well as off-site facilities, and consolidated rental car facilities that house multiple private companies
- **Roadways/Pavement:** all on-airport roadways whether owned and/or controlled by the airport operator
- **Signage:** all signage that uses lighting at an airport
- **Tenant Space:** all space leased to tenants (including airline and non-airline). This space may be subject to direct billing of utilities between tenant and utility provider
- **Terminal Areas Indoor:** the interior building envelope of public passenger processing areas
- **Terminal Areas Outdoor:** the exterior space surrounding the passenger processing terminals, including the curb front
- **Utility Plants:** co-generation facilities, centralized utility plants, and HVAC facilities

II.3.4 Page 4, Additional Information

This page of the Fact Sheet provides further information concerning the implementation of the strategy at other airports, possible funding, and available resources for the user to investigate and understand the strategy.

Case Study Examples

This section of the Fact Sheets identifies the application of the specific strategy at an airport, based on that airport's actual experience. Multiple cases are cited where possible.

On-Line Resources

URLs for websites are provided to further the user's understanding of the specific strategy and/or case study.

Funding Sources

Five options for where project funding may be derived are noted:

- **FAA AIP Funding:** This option refers to funding derived from the aviation trust fund and refers to the Airport Improvement Program (AIP). Based on a tax of airline tickets and aviation fuel, AIP funds can be used for runways, taxiways, ramps, lighting, signage, NAVAIDS, land acquisition, etc.
- **FAA VALE Grant Eligible:** In 2003, Congress created the Voluntary Airport Low Emission (VALE) Program to fund projects that would voluntarily reduce criteria pollutant emissions at airports. This program is presently designed to address criteria pollutants, but there have been suggestions to enable the program to fund greenhouse gas reduction strategies. Actions taken to reduce criteria pollutants would likely also reduce greenhouse gas emissions.
- **USEPA DERA Eligible:** Under the 2009 American Recovery and Reinvestment Act, the USEPA formed the Diesel Emission Reduction Act (DERA) that funded projects to reduce diesel emissions.
- **Passenger Facility Charge (PFC) Eligible:** The PFC allows the airline to collect up to $4.50 at the request of the airport for every enplaned passenger at that airport. Airports use these fees to fund FAA-approved projects.
- **Transportation Security Administration (TSA) Eligible:** To implement airport security measures, the TSA will occasionally fund projects, which may also achieve emission reductions.
- **Other Funding:** Other funding sources that may be applicable to a specific strategy.

Key References

Documents identified during the research effort that could assist the user with further information about the strategy are identified here.

Related Reduction Strategies

Other emission reduction strategies may supplement, be compatible with, or frequently occur at the same time as the selected strategy. This section enables a user to cross-reference the strategies to enhance the overall greenhouse gas reduction plan.

How to Use the Handbook, Fact Sheets, and AirportGEAR

For effective use of the technical information included in the Fact Sheets, users will need to understand three elements: (1) use of the background information included in the Handbook, (2) application of technical information in the Fact Sheets, and (3) use of AirportGEAR. This section identifies how to use these resources to achieve a specific objective.

This section is organized as follows:

III.1   How to Use This Handbook and the Fact Sheets
III.2   Example Uses of the Fact Sheets
III.3   How to Use AirportGEAR (the accompanying electronic decision-support tool)

Step-by-step instructions are provided in the following sections.

III.1 How to Use This Handbook and the Fact Sheets

The Handbook/Fact Sheets can be used for two main purposes:

1. To explore background information important for understanding greenhouse gas reduction activities and programs
2. To search Fact Sheets for information that will assist in understanding and selecting greenhouse gas reduction strategies

To present information collected and analyzed through this research project, Fact Sheets were prepared that summarize the technical information for each strategy. Section II of this Handbook provides detailed information concerning how the Fact Sheet information was assembled and how they may be used to select greenhouse gas reduction strategies appropriate for a specific facility or project. The Fact Sheets are presented in Appendix A on the CD-ROM that accompanies this Handbook.

The Fact Sheets can be used to serve many purposes, most of which fall into one of the following three categories:

• To gain familiarity with the types of strategies that are applicable to airports
• To review detailed information and implementation issues associated with a specific strategy
• To identify and select strategies that have the greatest ability to achieve a desired objective

The use of this Handbook will depend on the user and the need for information. Therefore, each of these three approaches is discussed separately here and in Section III.2, which describes example uses of the Fact Sheets.

Note: Using AirportGEAR, the user can also prepare an estimate of the emission reductions and unit cost of reducing carbon that would occur with an individual or group of strategies based on user-defined information. This calculation process is not available through manual use of the

Handbook. In addition, AirportGEAR calculates a numerical score for each strategy that is based on rating values for specific evaluation criteria and incorporates user-defined prioritization of the criteria. The numerical scores are normalized to be between 1 and 100, to represent the lowest to highest match to the user's preferences.

III.1.1 Gain Familiarity with Greenhouse Gas Emission Reduction Strategies

At the time this Handbook was prepared, many airports were just beginning to consider broad programs or activities for reducing greenhouse gases. In other cases, a few individual airports were preparing comprehensive Climate Action Plans and incorporating sustainability in their development activities and ongoing operations. In both cases, users are often seeking information sources to gain familiarity with strategies in use by other airports. For these types of general information uses, the following steps are suggested.

Step 1: Become familiar with greenhouse gas accounting principles to enable capturing the emission reductions that could be achieved by implementing one or more of the strategies considered. This step provides an important foundation to understanding which emission sources are reflected in an airport inventory, and how they are presented. Greenhouse gas accounting principles are noted in Section IV of this report.

Step 2: Review the information included in the Fact Sheets. To enable the Handbook and AirportGEAR to be useful in a wide range of airport operations, specific evaluation criteria, such as estimated capital cost and implementation timeframe, were selected and each strategy was analyzed relative to these criteria. In addition to the evaluation criteria, the Fact Sheets also include other relevant information to aid a user with understanding the benefits and consequences of implementation of individual strategies. Once the user is familiar with the type of information presented in the Fact Sheets, the issues and benefits associated with each strategy and how to best use the information become apparent. More information on the evaluation criteria and Fact Sheet information are found in Section II.

Step 3: Identify the local priorities and goals or the importance of the criteria relative to the specific airport situation. Each user is likely to have different priorities or emission reduction goals for a specific airport. The ability of the strategies to be integrated into that airport's programs will depend on the relative importance of the criteria (e.g., estimated capital cost vs. implementation timeframe). Section II identifies issues that the user may wish to consider relative to local priorities and goals.

Step 4: Review strategies. Table I-1 presented the listing of the 125 greenhouse gas reduction strategies identified by this research.

Users can decide to limit their review to specific strategies or categories of strategies (e.g., energy management or ground transportation). Users can also match up the local priorities/goals with the evaluation criteria (see Sections II.2 and II.3). The next subsection discusses narrowing the strategies reviewed.

Each of the previous steps will aid the user in becoming familiar with the broad range of strategies available and/or in use, as well as the information provided for each strategy.

III.1.2 Identify Issues Associated with a Specific Strategy or Groups of Strategies

The review of individual strategies can follow the same approach described in Section III.1.1. However, the user would likely add a step that narrows the strategies based on the user's interest. The following steps could be added to those described in the preceding subsection.

Step 5: Identify area of interest to narrow the search. The information presented in the Handbook and AirportGEAR was designed to be as informative as possible and allow users to apply the information to their specific interest. Therefore, users can narrow their review based on specific interests that may include one or both of the following:

- *Category of Strategy* (e.g., airfield design and operation, energy management, ground transportation, etc.). Section II.1 identifies the strategy categories. Categories were given two-letter identifiers that the user should note for carrying forward to the next step. For instance, if the user is interested in ground transportation strategies, the user would note "GT." These strategy category codes are on the top header of every page of every Fact Sheet.
- *Evaluation Criteria Considerations* (e.g., financial, implementation, impact). This type of search would focus on the consequence of the strategies. For instance, users may be interested in strategies with a particular payback period and/or the amount of time that it takes to implement a strategy. The evaluation criteria addressed in these considerations are described in Section II.2. Users should identify which criteria are of interest to their search and the location of that information on the Fact Sheet. Section II.3 identifies the location of information on each Fact Sheet.
- *Other Applicable Characteristics.* Users can determine if strategies would be applicable to their airport by looking at such characteristics as favorable geographic location, airport size, area of the airport or required space needed for implementation. Case study information may also be used to narrow the strategies for a specific airport.

Based on the three items above, users should note which of these areas they would like to use to narrow their review.

Step 6: Locating the strategy(ies) of interest. AirportGEAR enables the strategy(ies) of interest to be found electronically, which is described separately in Section III.3. For users interested in specific evaluation criteria or other characteristics, the Fact Sheets were prepared with text descriptions as well as easy-to-identify icons. To manually find the strategy(ies) of interest, the user will need to know a specific category code (e.g., GT for ground transportation) to locate the strategies based on that code or will need to scan the Fact Sheets for specific icons or text (e.g., to find the strategies with the lowest capital cost, scan the Fact Sheets for the single $ icon). Sections II.2 and II.3 identify the meaning of each icon and the location of the icons and text on each Fact Sheet.

This type of user would then apply the information concerning the selected strategies as needed. Examples of this type of review are provided in Section III.2.

III.1.3 Identify and Select Strategies that Have the Greatest Ability to Achieve a Desired Objective

This use of the Handbook and AirportGEAR requires the greatest level of user knowledge and advancement; it assumes that the user has familiarity with greenhouse gas accounting principles and airport sources as described earlier or through separate efforts. The additional steps that would then be used to match the local goals and priorities with information in the Fact Sheets/AirportGEAR are discussed in this subsection.

Step 1: Review the information included in the Fact Sheets. To enable the Handbook and AirportGEAR to be useful in a wide range of airport operations, specific evaluation criteria, such as capital cost and implementation timeframe, were selected and each strategy assessed relative to these criteria. In addition to the evaluation criteria, the Fact Sheets also include other relevant information needed to understand the consequences of the strategy's implementation. Once the user is familiar with the type of information presented in the Fact Sheets, they can then better understand the issues and benefits associated with each strategy and how to best use the information. More information on the evaluation criteria and Fact Sheet contents is found in Section II.

Step 2: Identify the local priorities and/or goals. As achieving a specific goal is the focus of this type of deployment, the goal will form a basis for narrowing the broad list of strategies to those meeting the airport's need. Such goals and priorities are unique to the local setting and user.

Step 3: Match goals/priorities with the evaluation criteria and information included in the Fact Sheets. This approach allows users to select information meeting their specific interest. Airport goals and priorities are often focused on a specific user, source, or condition at the airport, which could be identified by any one of the characteristics described in Section II. While the number of possible criteria that can be used for matching goals/priorities to strategies is extensive, the following are the most likely to be used:

- *Emission source:* either by Scope designation or by more refined categories, such as those listed on page 3 of the Fact Sheets (e.g., purchased electricity, fleet vehicles, etc.);
- *Implementation area* of the airport, reflecting airport functional areas;
- *Costs* (as noted on page 2 of the Fact Sheet with an icon or in the Financial Considerations text discussion); and/or
- *Emission reduction achieved:* in a manual search, by using icons for general emission reduction on the first and second pages of each Fact Sheet. AirportGEAR would assist the user with identifying a general emission reduction in actual tons per year.

Through this step, users will note the specific information in which they are interested. Section II.3 identifies the location of the information on each Fact Sheet.

Step 4: Locating the strategy(ies) of interest. AirportGEAR enables the strategy(ies) of interest to be found electronically, which is described separately in Section III.3 of this Handbook. The Fact Sheets in Appendix A were prepared with text descriptions as well as icons. During the prior step, the user will have identified a specific category code (e.g., GT for ground transportation) to locate the strategies based on that code or will need to visually scan the Fact Sheets for specific user-selected icons or text. Section II identifies the meaning of each icon and the location of the icons and text on each Fact Sheet.

III.2 Example Uses of the Fact Sheets

To aid users with understanding how to use the Fact Sheets, the following subsections provide examples of their use.

III.2.1 Gain Familiarity with Types of Strategies

One example is provided to assist the user with understanding the process of becoming familiar with a type of emission reduction strategy. To gain this familiarity, the user could begin by just reading the Fact Sheets. The following example could help with focusing that review.

For this example, a user might wish to become familiar with strategies that could be applied by the airport operator to reduce its greenhouse gas emissions. This is about as broad a use of the Handbook and AirportGEAR as possible. As each airport and airport operator organization is different, the strategies that one airport may review could be different from that of another airport.

Scenario

For this airport, let us assume that the airport is city owned and is a separate department of the city that relies on the city police and fire departments for services but has its own airport maintenance functions. The airport is a small hub airport processing 2 million enplaned passengers and 130,000 annual aircraft operations. At this time, the airport does not have a greenhouse gas reduction target, but anticipates one in the future, and is beginning the process of understanding

how the airport's emissions could be reduced. The following paragraphs identify how the Handbook might be used for this review purpose.

Step 1. Section IV of the Handbook identifies greenhouse gas accounting principles. Users are encouraged to review this section, as it can facilitate understanding the emissions boundary principles employed in the Fact Sheet. In the case of the example airport, Section IV would enable the user to note how the sources at the airport are represented in the inventory and which sources are considered Scope 1 and 2 versus Scope 3. Based on this discussion, users might wish to begin formulating which sources fall within their Scope 1 and 2 designation versus Scope 3. Users may also wish to identify categories of sources for which they may have control and can show their influence. For example, some airports can control access to ground transportation sources.

Step 2. In this step, the user would review the various characteristics of the emission reduction strategies (Section II) that were evaluated. This step enables the user to narrow the strategies to either geographic regions, types of sources, or some attribute of interest. For purposes of gaining familiarity with strategies, users would be able to note their areas of interest. Again for this example, we will assume that through this review, the user will note where the information is provided concerning Scope 1 and 2 sources (those sources under their ownership and control).

Step 3. The review of Sections II.2 and II.3 are done solely to have the less experienced user gain familiarity with the types of issues that could arise with various actions and to connect these issues with characteristics of local importance. A review of this type will enable the user to gain an understanding of the contents of the Fact Sheets and begin to visualize how that information may be used. For instance, for an airport with little funding available for programs, the user may wish to seek strategies with low cost, or with a swift payback, or where grant monies may be available. If specific characteristics are of greater interest to the user, they may then wish to narrow their search, through the second or third type of review discussed in subsequent subsections.

Step 4. Now that the user has a foundation in how sources are represented in the inventory, the various characteristics that the Handbook considers, and how the Fact Sheets are constructed, the user can move to reviewing the strategies located in Table I-1.

III.2.2 Identify Issues Associated with a Specific Strategy

This type of review can start with the preceding subsection if the user has not worked with the Handbook. Continuing the prior example, the user has already established familiarity with emission reduction strategies and how the information is presented in the Fact Sheets. In this example, that user might now be seeking to find a specific strategy or groups of strategies. Three examples are provided for this type of review:

A. The user is seeking a category of strategies.
B. The user is seeking strategies that meet one or more of the analysis considerations.
C. The user is seeking to determine if the strategy would be applicable to the airport's situation.

Example A

The user in Example A might be seeking to review all strategies that affect surface vehicles using the airport.

Steps 5 and 6. In this instance, the user would search for strategies that affect surface vehicles. This search can be done using three approaches.

First, all ground transportation-related strategies are noted with the category designator GT (see Table III-1). The user could search all GT strategies. As noted in Table I-1, there are 17 separate ground transportation-related strategies identified (GT-01 through GT-17).

Second, on page 3 of each Fact Sheet, in the middle, is a section titled, "Reduction Action Affects the Following GHG Sources." Users could search for those strategies that involve ground vehicles, listed as "On Road Vehicles," "Fleet Vehicles," "Passenger Support Vehicles," "On Airport Passenger Support Vehicles," "Employee Parking Lot Transport," "Construction Equipment," etc. These strategies would be found either visually by scanning the Fact Sheets in Appendix A or automatically using AirportGEAR.

Third, also on page 3 of the Fact Sheets, under Functional Area, actions that affect ground transportation are noted by four categories: Parking, Public Transportation Facilities, Rental Car Facilities, and Roadways/Pavement. The user could find these strategies either manually by scanning the Fact Sheets in Appendix A or automatically using AirportGEAR.

Example B

The user in Example B might be seeking to review all strategies that (1) affect surface vehicles using the airport *and* (2) have a short payback period.

Steps 5 and 6.   In this instance, the user would search for strategies that affect surface vehicles, as was demonstrated in Example A. Then, these strategies would be further narrowed, based on the quick-scan interpretative icon under Estimated Payback Period on page 1 or 2; users would identify those with a single wrench as having the fastest payback period.

Using the first approach, the GT strategies and their payback period rating values are identified as shown in Table III-1.

Table III-1 shows that no ground transportation strategies have a short payback, as strategy GT-08 (Implement a Traffic Management System) received the lowest rating at 3; the rating 3 indicates a payback period of 6 to 10 years, and the rating 4 indicates a period greater than 10 years.

Table III-1.   Examples A and B: ground transportation strategies and their payback period ratings.

	Strategy	Payback Rating
GT-08	Implement a Traffic Management System	3
GT-13	Promote Bicycle Use by Employees	4
GT-14	Convert Airport Fleet Vehicles to Alternatively Fueled Vehicles	4
GT-01	Provide Priority Vehicle Parking for Emissions Friendly Vehicles	4
GT-10	Allow Flexible Work Schedules for Employees	4
GT-11	Build Consolidated Rent-A-Car Facility (ConRAC)	4
GT-12	Construct a Personal Rapid Transit (PRT) System	4
GT-15	Support Conversion of Tenant Fleet Vehicles to Alternatively Fueled Vehicles	4
GT-16	Support Alternatively Fueled Vehicles for Rental Cars and Commercial Vehicles	4
GT-17	Support Alternatively Fueled Taxis	4
GT-02	Provide Preferential Car/Vanpool Parking for Employees	4
GT-03	Promote Public Transit to the Airport	4
GT-04	Provide Transit Fare Discounts and/or Alternative Mode Subsidies	4
GT-05	Increase Mass Transit Access to the Airport	4
GT-06	Alter Parking Pricing Structures for Employees and Passengers	4
GT-07	Implement "On-foot" Payment for Parking	4
GT-09	Allow Telecommuting for Employees	4

Example C

Expanding Example B further, the user might be seeking to identify ground transportation strategies that have a quick payback period and are applicable to the airport's region of the country. For this scenario, the airport is located in Missouri.

Steps 5 and 6.   Based on the geographic regions used in this analysis, Missouri would fall in the Lower Midwest. Therefore, the user would search for strategies that affect surface vehicles, have a quick payback, and are favorable for implementation in the Lower Midwest.

Using the first approach, the user would identify those strategies labeled GT and then review page 3 of each Fact Sheet to identify whether the strategy is favorable or unfavorable based on the geographic location. Table III-2 presents the results after a visual scan of the ground transportation strategies. Note that a payback period rating of 3 indicates a period of 6 to 10 years, whereas a payback period rating of 4 indicates a period greater than 10 years. No ground transportation strategies were estimated to have a payback period less than 6 years.

Thus, all ground transportation strategies have a similar payback period and are geographically favorable to the example airport.

As users will find, tremendous time savings can be achieved from the use of AirportGEAR to conduct more complex reviews of various strategies.

Table III-2.   Example C: Ground transportation strategies and their payback period rating and applicability in the Lower Midwest Region.

	Strategy	Payback Rating	Lower Midwest Geography
GT-08	Implement a Traffic Management System	3	Favorable
GT-13	Promote Bicycle Use by Employees	4	Favorable
GT-14	Convert Airport Fleet Vehicles to Alternatively Fueled Vehicles	4	Favorable
GT-01	Provide Priority Vehicle Parking for Emissions Friendly Vehicles	4	Favorable
GT-10	Allow Flexible Work Schedules for Employees	4	Favorable
GT-11	Build Consolidated Rent-A-Car Facility (ConRAC)	4	Favorable
GT-12	Construct a Personal Rapid Transit (PRT) System	4	Favorable
GT-15	Support Conversion of Tenant Fleet Vehicles to Alternatively Fueled Vehicles	4	Favorable
GT-16	Support Alternatively Fueled Vehicles for Rental Cars and Commercial Vehicles	4	Favorable
GT-17	Support Alternatively Fueled Taxis	4	Favorable
GT-02	Provide Preferential Car/Vanpool Parking for Employees	4	Favorable
GT-03	Promote Public Transit to the Airport	4	Favorable
GT-04	Provide Transit Fare Discounts and/or Alternative Mode Subsidies	4	Favorable
GT-05	Increase Mass Transit Access to the Airport	4	Favorable
GT-06	Alter Parking Pricing Structures for Employees and Passengers	4	Favorable
GT-07	Implement "On-foot" Payment for Parking	4	Favorable
GT-09	Allow Telecommuting for Employees	4	Favorable

III.2.3 Identify and Select Strategies with the Greatest Ability to Achieve an Objective

For this discussion, we will continue with our prior scenario. With this form of strategy search, assume that the airport has now adopted or embraced an emissions objective. This search could focus on identifying the strategies that achieve the greatest emission reduction. Two examples are provided: the first builds on the prior examples (regionally favorable ground transportation strategies with a quick payback) and now seeks the greatest emission reduction. The second example seeks *all* strategies that would achieve the greatest emission reduction, regardless of source.

Example 1

To find ground transportation strategies that are regionally favorable and have a high payback, the search would determine which strategies have the greatest emission reduction potential. Note: Using the Fact Sheets, users will not be able to quantify a specific emission reduction; however, using AirportGEAR, users can estimate the emissions reduction associated with an action if they take the time to enter some project-specific information.

The Fact Sheet review would yield the following strategies along with the degree of their emission reduction benefits. A payback period rating of 3 represents an estimated 6- to 10-year payback, whereas a rating of 4 indicates over 10 years. The greenhouse gas emission reduction potential ratings for Scopes 1 & 2 and Scope 3 are highest at 3 and lowest at 0 (or no emission reduction). As all of the ground transportation strategies are geographically favorable, that information was dropped from the matrix. Table III-3 summarizes the results.

Table III-3. Example 1: Ground transportation strategies and their payback period rating and greenhouse gas reduction potential for Scopes 1 & 2 and Scope 3.

Strategy		Strategy Rating		
		Payback	Scopes 1 & 2	Scope 3
GT-08	Implement a Traffic Management System	3	2	2
GT-13	Promote Bicycle Use by Employees	4	2	2
GT-14	Convert Airport Fleet Vehicles to Alternatively Fueled Vehicles	4	2	0
GT-01	Provide Priority Vehicle Parking for Emissions Friendly Vehicles	4	0	1
GT-10	Allow Flexible Work Schedules for Employees	4	0	1
GT-11	Build Consolidated Rent-A-Car Facility (ConRAC)	4	0	2
GT-12	Construct a Personal Rapid Transit (PRT) System	4	0	2
GT-15	Support Conversion of Tenant Fleet Vehicles to Alternatively Fueled Vehicles	4	0	2
GT-16	Support Alternatively Fueled Vehicles for Rental Cars and Commercial Vehicles	4	0	2
GT-17	Support Alternatively Fueled Taxis	4	0	1
GT-02	Provide Preferential Car/Vanpool Parking for Employees	4	0	2
GT-03	Promote Public Transit to the Airport	4	0	2
GT-04	Provide Transit Fare Discounts and/or Alternative Mode Subsidies	4	0	2
GT-05	Increase Mass Transit Access to the Airport	4	0	2
GT-06	Alter Parking Pricing Structures	4	0	2
GT-07	Implement "On-foot" Payment for Parking	4	0	1
GT-09	Allow Telecommuting for Employees	4	0	1

Payback period ratings: 1 = less than 2 years, 2 = 2–5 years, 3 = 6–10 years, and 4 = more than 10 years.
Greenhouse gas reduction potential ratings for Scopes 1 & 2 and Scope 3: 3 = highest emission reduction, 0 = no emission reduction.

Based on the assembled ground transportation strategies, the strategy that has the quickest payback and the highest emission reduction potential is GT-08, Implement a Traffic Management System. As most of the ground transportation-related strategies have a slow payback (rating of 4), the strategy with the next greatest emission reduction benefit would be GT-13, Promote Bicycle Use by Employees, followed by GT-14, Convert Airport Fleet Vehicles to Alternatively Fueled Vehicles.

Example 2

This example begins without limits on the sources achieving emission reduction (i.e., is not limited to ground transportation) but rather seeks to identify strategies that achieve the greatest emission reduction with the swiftest payback (a payback rating of 1) while also having a high emission reduction (a rating of 3 or 2 starting with Scopes 1 & 2, followed by Scope 3). The strategies in Table III-4 would meet these criteria.

As Table III-4 shows, only one strategy was identified that has a payback of less than 2 years *and* is estimated to have the highest emission reduction: RF-02 (Incorporate Intelligent Fault

Table III-4.   Example 2: Strategies that achieve the fastest payback and greatest greenhouse gas reduction potential for Scopes 1 & 2 and Scope 3.

Strategy		Strategy Rating		
		Payback	Scopes 1 & 2	Scope 3
RF-02	Incorporate Intelligent Fault Diagnosis for HVAC Systems	1	3	2
BP-03	Develop a Climate Action Plan	1	2	2
EM-18	Implement a Lighting System Energy Conservation Program	1	2	1
EM-31	Purchase ENERGY STAR Equipment	1	2	1
AF-18	Support the Use of Paperless Ticket Technology	1	1	1
PM-02	Perform Energy Audits	1	1	1
AF-17	Support Fuel Efficiency Targets for Aircraft	1	0	1
CN-03	Implement a Construction Vehicle Idling Plan	1	0	1
CN-05	Specify Energy Efficient Temporary Lighting During Construction	1	1	1
EM-07	Evaluate Fuel Mix	2	3	2
RF-01	Replace Refrigerants with Natural or Lower GWP Gases	2	3	2
RF-04	Install Microchannel Components and Heat Exchangers	2	3	2
EM-08	Use Thermal Imaging to Identify Energy Losses	2	2	2
EM-09	Improve Insulation of Building Envelope	2	2	2
EM-10	Change Set Points or Exclude Selected Zones from Heating and Cooling	2	2	2
EM-14	Design Building Orientation for Energy Use Reduction	2	2	2
EM-25	Install Evaporative Cooling Systems	2	2	2
EM-30	Reduce Transmission Losses in Electric Wires	2	2	2
EM-37	Incorporate Use of Natural Ventilation and Economizer Control	2	2	2

Note: Shaded strategies would achieve fastest payback, with simultaneous higher emission reduction.

Payback period ratings: 1 = less than 2 years, 2 = 2–5 years, 3 = 6–10 years, and 4 = more than 10 years.

Greenhouse gas reduction potential ratings for Scopes 1 & 2 and Scope 3: 3 = highest emission reduction, 0 = no emission reduction.

Diagnostic for HVAC Systems). Three strategies have a payback of less than 2 years but only moderate emission reductions (BP-03, Develop a Climate Action Plan; EM-18, Implement a Lighting System Energy Conservation Program; and EM-31, Purchase ENERGY STAR Equipment).

III.3 How to Use AirportGEAR

As part of this ACRP research project, a decision-support tool, AirportGEAR was developed to assist users with analyzing the technical information included for the various greenhouse gas emission reduction strategies. AirportGEAR is a self-contained computer application. It is a stand-alone, desktop application written for the Windows operating system. The only requirements or system prerequisites for users wishing to install and use this tool is Adobe Reader. All AirportGEAR tool dependencies, such as the Microsoft .NET 3.5 Framework, are included in the application installation package.

AirportGEAR is an interactive decision-support tool designed to assist airport operators in prioritizing and selecting the greenhouse gas emission reduction strategies that are most appropriate for a specific airport based on local information. While the tool is based on the same technical information included in the Fact Sheets in the Handbook, AirportGEAR enables more active functions to analyze the information so that users can prioritize and select strategies and create plans that meet their specific requirements and preferences for implementation. AirportGEAR is a self-contained application.

AirportGEAR includes six features to assist airport operators in evaluating, prioritizing, selecting, and planning for implementation of greenhouse gas emissions reduction strategies for facilities or projects. The ultimate product of using AirportGEAR is a written report, or series of reports, that includes:

- A list of the greenhouse gas reduction strategies selected by the user for a facility or project after evaluation and prioritization;
- Key information about each of the selected strategies, such as greenhouse gas reduction potential, a numerical score calculated by AirportGEAR based on the rating values for the evaluation criteria, unit cost of carbon in dollars per metric tonne of carbon dioxide equivalent reduced, and applicability to Scope 1 (direct), Scope 2 (indirect), and Scope 3 (other) emissions; and
- A comparison of the airport's existing greenhouse gas inventory to the inventory that would result from implementation of the selected strategies (assuming the greenhouse gas inventory data is supplied by the user, which is not a requirement for using AirportGEAR).

The report(s) is intended to facilitate discussions about greenhouse gas mitigation and to assist in decision-making activities related to greenhouse gas reduction at specific facilities or for specific projects.

The features of AirportGEAR are designed to assist airport operators in reducing greenhouse gas emissions whether they are in the initial stages of learning about greenhouse gas mitigation or have a mature emission reduction program. Airport operators at different levels of progress in their greenhouse gas reduction activities will find different AirportGEAR features more useful to them depending on their current and planned activities. Guidance on using AirportGEAR based on different types of users is discussed in Section III.3.2 and included in the AirportGEAR User's Manual (Appendix B of this Handbook).

III.3.1 AirportGEAR Features

The six major AirportGEAR features, their purposes, and their interactions with one another are presented in Figures III-1 and III-2 and are described subsequently.
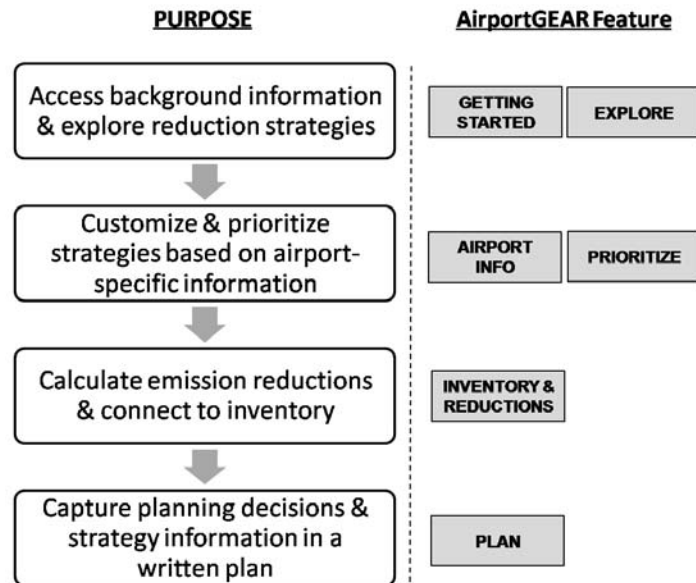
Figure III-1.   AirportGEAR features and their purpose.
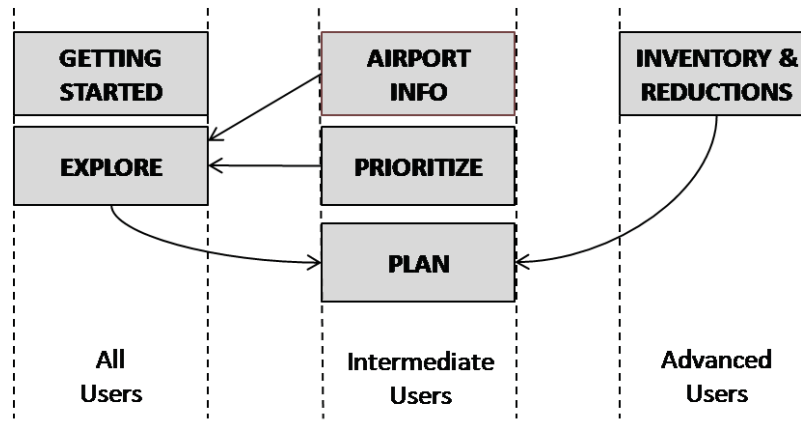
Figure III-2.   AirportGEAR features and their interactions with one another.

GETTING STARTED

Users can read through background information about the reduction strategies and how to use AirportGEAR to reduce greenhouse gas emissions. Figure III-3 presents the screenshot for **GETTING STARTED.**

EXPLORE

Users can browse, sort, filter, and search the 125 reduction strategies or access the LIBRARY of documents that contain background information. From **EXPLORE,** users can also select strategies for a facility or project and add them to a plan in the **PLAN** feature. Figures III-4, III-5, and III-6 depict the screenshots for **EXPLORE.**
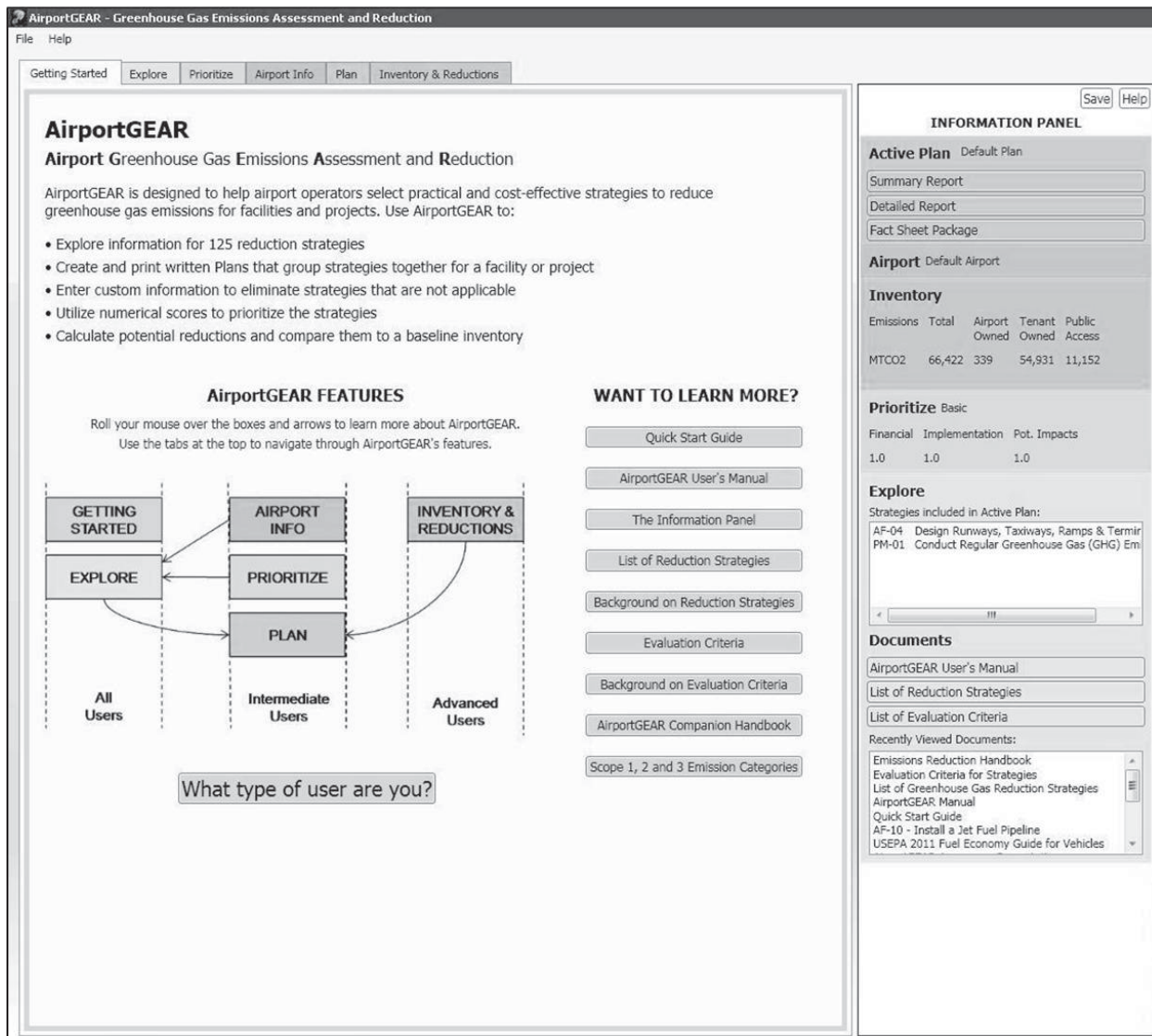
Figure III-3.   Screenshot of GETTING STARTED.

AirportGEAR - Greenhouse Gas Emissions Assessment and Reduction

File Help

Getting Started | Explore | Prioritize | Airport Info | Plan | Inventory & Reductions

List | Search | Library

⦿ Show All ◯ Show Only SEARCH Results | Refresh Scores

Add To Plan	Strategy Number	Strategy Name	Total Score	Capital	O/M	Payback	Timeframe	Maturity	Control	Scop 1-2
ADD	PM-01	Conduct Regular Greenhouse Gas (GHG) Emission Inventories	64	2	1	4	1	4	4	2
ADD	AF-01	Provide Infrastructure for Pre-Conditioned Air (PCA) and Ground Power	53	4	4	4	2	4	2	0
ADD	AF-03	Design Airside Layout to Reduce Aircraft Delay and Surface Vehicle Congestion	64	4	3	4	2	4	4	0
ADD	AF-04	Design Runways, Taxiways, Ramps & Terminals to Reduce Aircraft Taxiing Distances	67	4	3	4	4	4	4	0
ADD	AF-05	Consider Longer Runways to Reduce the Use of Reverse Thrust	53	4	3	4	4	4	4	0
ADD	AF-07	Provide Fixed Gate Infrastructure for Aircraft Underground Supply and Evacuation Systems	58	3	3	2	2	4	4	1
ADD	AF-02	Minimize the Use of Auxiliary Power Units (APUs)	64	2	1	4	1	4	4	0
ADD	AF-13	Support the Development of Alternative Fuels for Aircraft	47	1	1	4	2	2	2	0
ADD	AF-12	Support Modernization of Air Traffic Management (ATM)	72	1	1	4	3	3	3	0
ADD	AF-14	Support Single/Reduced Engine Taxiing	67	1	1	4	2	4	1	0
ADD	AF-15	Support Alternative Passenger Boarding Procedures	53	3	2	4	3	2	2	0
ADD	AF-16	Support Push Back Tugs to Transport Planes to Taxiways, Runway Ends and/or Take-off Areas	58	1	1	4	2	1	1	0
ADD	AF-11	Support Optimized Departure Management on Existing Runways	67	2	2	3	1	4	2	0
ADD	AF-06	Install or Expand Hydrant Fueling System	47	4	4	4	3	4	4	0
ADD	AF-10	Install a Jet Fuel Pipeline	47	4	4	4	3	3	4	0
ADD	AF-08	Create Partnerships with Intercity Rail Services to Optimize Passenger and Cargo Movement	61	4	2	4	3	4	2	0
ADD	AF-09	Implement Emission-based Incentives and Landing Fees	67	1	1	4	2	3	2	0
ADD	AF-17	Support Fuel Efficiency Targets for Aircraft	72	1	1	1	1	4	2	0
ADD	AF-18	Support the Use of Paperless Ticket Technology	67	1	1	1	1	4	1	1
ADD	BP-02	Develop an Airport Expansion and Development Greenhouse Gas Emission Policy	64	2	1	4	1	2	4	2
ADD	BP-03	Develop a Climate Action Plan (CAP)	81	2	1	1	2	4	4	2
ADD	BP-04	Develop Climate Change and Energy Communication Materials and/or Information Center	53	1	1	4	1	3	4	1
ADD	BP-07	Offer Voluntary Carbon Offsets for Passengers	44	3	1	4	1	3	4	0
ADD	BP-06	Develop and Apply or Sell Carbon Offsets	67	3	1	4	2	3	4	3
ADD	BP-08	Use Airport-Specific Sustainable Planning, Design, and Construction Guidelines	78	2	1	4	2	4	4	2
ADD	BP-10	Set a Policy for Green Building Certification for Buildings	78	2	1	4	2	4	4	2
ADD	BP-11	Support the Use of Customer Self-Service Equipment in Terminal Design	61	1	1	4	1	4	2	1
ADD	CS-04	Invest in Terrestrial Carbon Sinks	78	1	1	4	4	3	4	2
ADD	CS-01	Install Sustainable, Long-term Vegetation	64	1	2	4	2	3	4	1

Save Help

INFORMATION PANEL

Active Plan Default Plan

Summary Report

Detailed Report

Fact Sheet Package

Airport Default Airport

Inventory

Emissions Total | Airport Owned | Tenant Owned | Public Access

MTCO2 66,422 339 54,931 11,152

Prioritize Basic

Financial Implementation Pot. Impacts
1.0 1.0 1.0

Explore

Strategies included in Active Plan:

AF-04 Design Runways, Taxiways, Ramps & Termir
PM-01 Conduct Regular Greenhouse Gas (GHG) Em

Documents

AirportGEAR User's Manual

List of Reduction Strategies

List of Evaluation Criteria

Recently Viewed Documents:

Emissions Reduction Handbook
Evaluation Criteria for Strategies
List of Greenhouse Gas Reduction Strategies
AirportGEAR Manual
Quick Start Guide
AF-10 - Install a Jet Fuel Pipeline
USEPA 2011 Fuel Economy Guide for Vehicles

Figure III-4.   Screenshot for the LIST tab in EXPLORE.
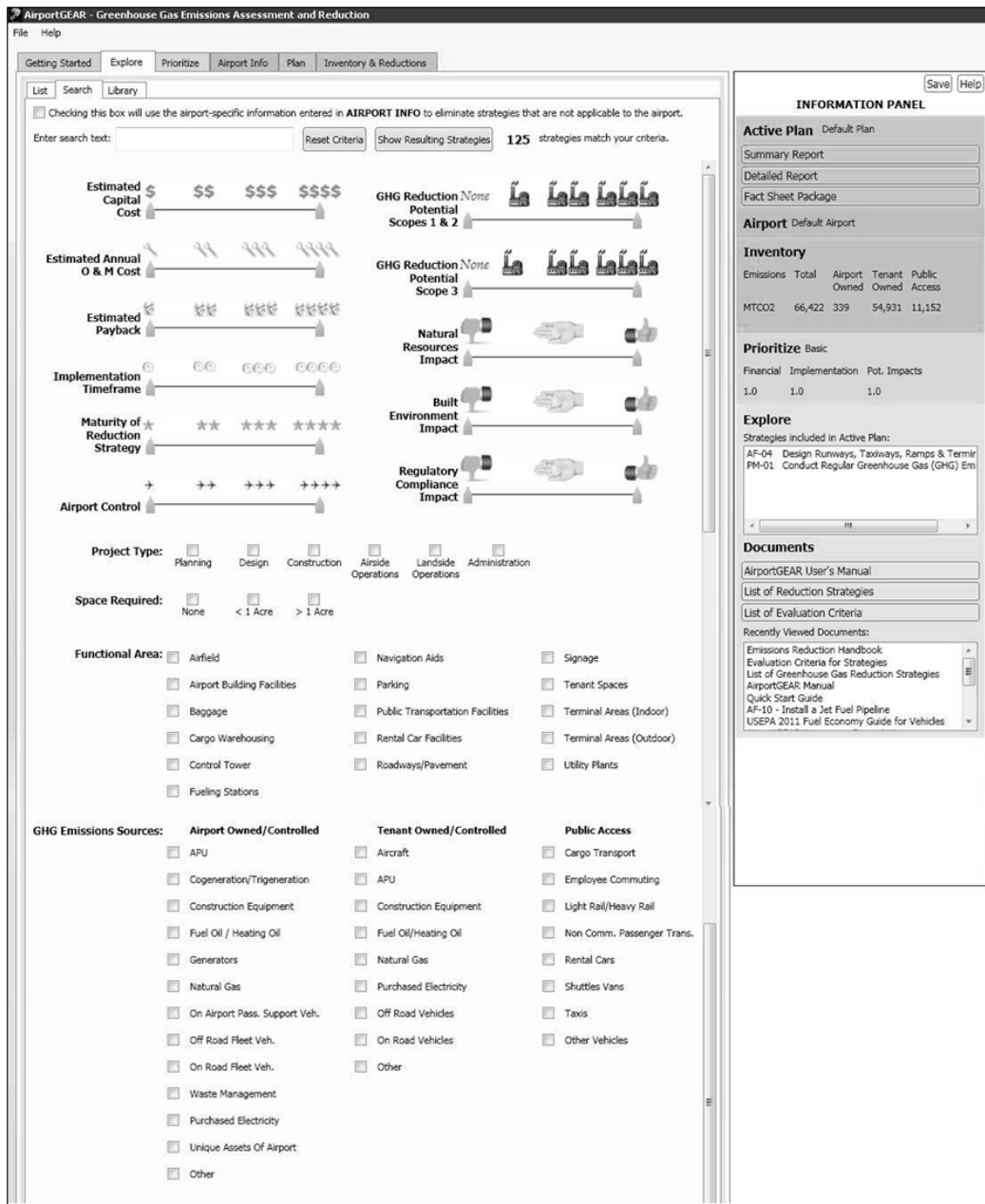
Figure III-5.   Screenshot for the SEARCH tab in EXPLORE.
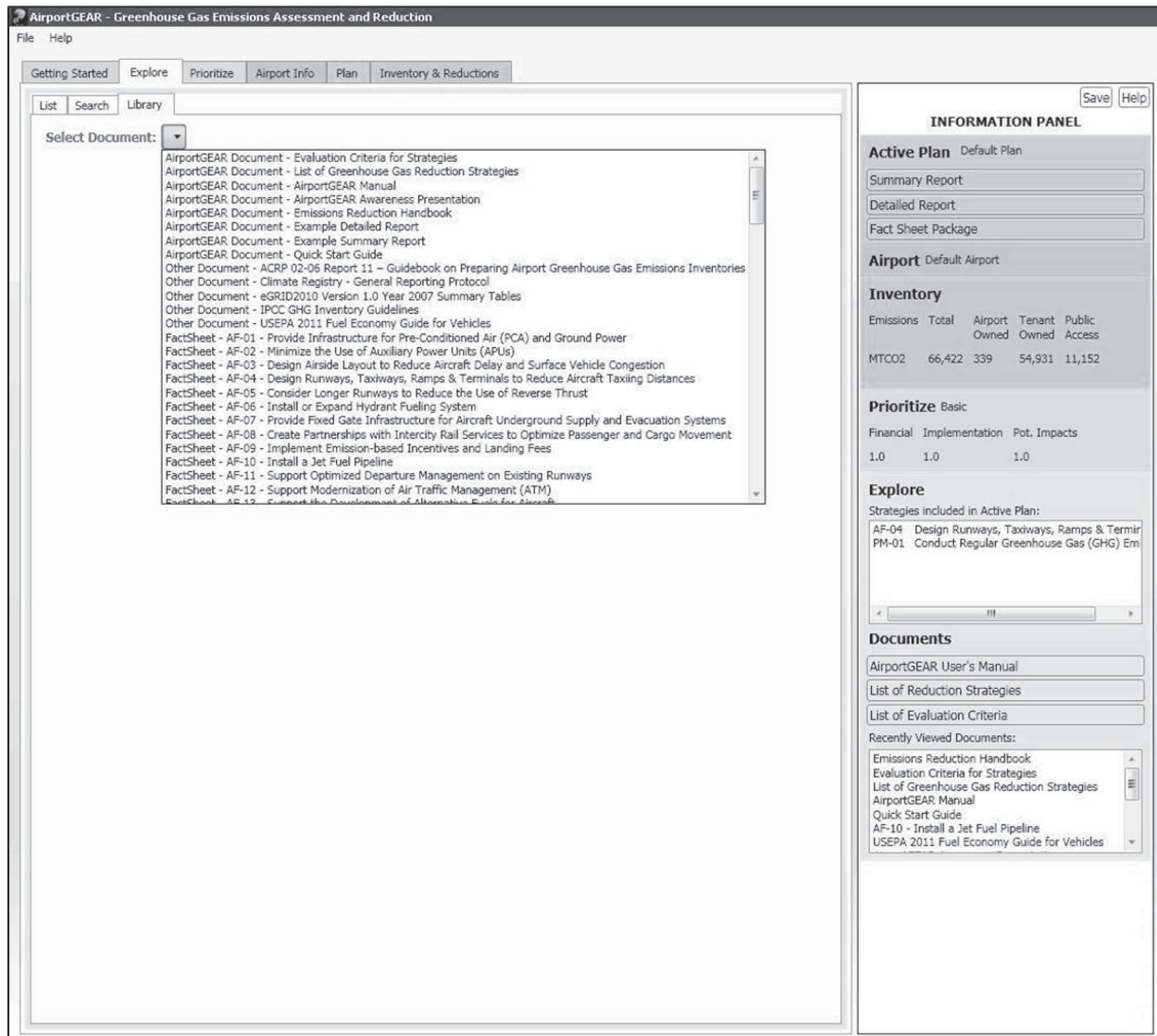
Figure III-6.   Screenshot of the LIBRARY tab in EXPLORE.

PRIORITIZE

Users can rank the evaluation criteria (e.g., cost) to prioritize the reduction strategies according to their needs and preferences. The custom prioritization of the evaluation criteria changes the numerical score calculated by AirportGEAR for each strategy, thus allowing users to see which strategies are most applicable to their facility or project (i.e., the strategies with the highest numerical scores are the most desirable). The numerical scores are presented in the LIST tab in **EXPLORE.** Figures III-7 and III-8 depict the screenshots for **PRIORITIZE.**
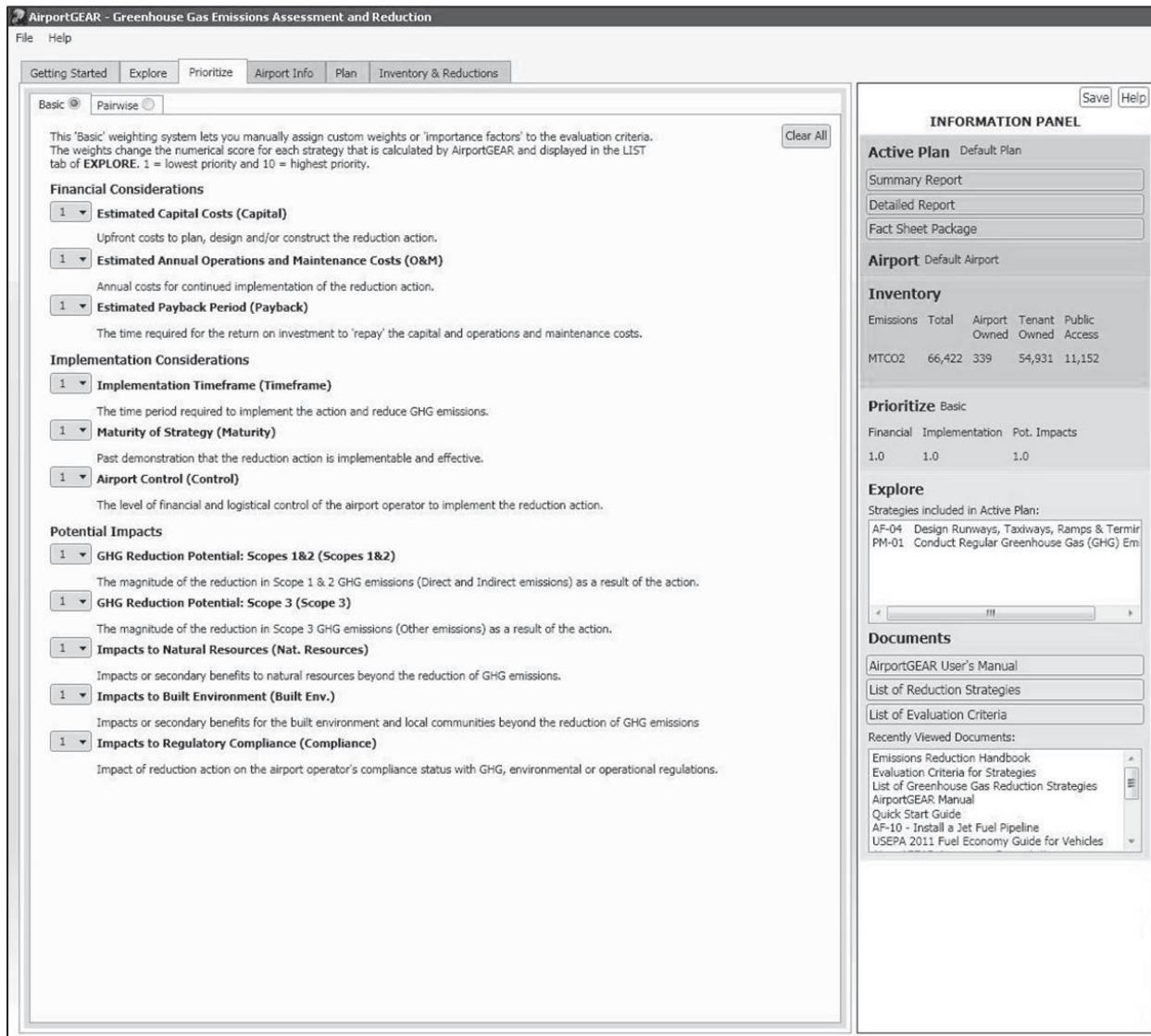
Figure III-7.   Screenshot for the BASIC tab in PRIORITIZE.
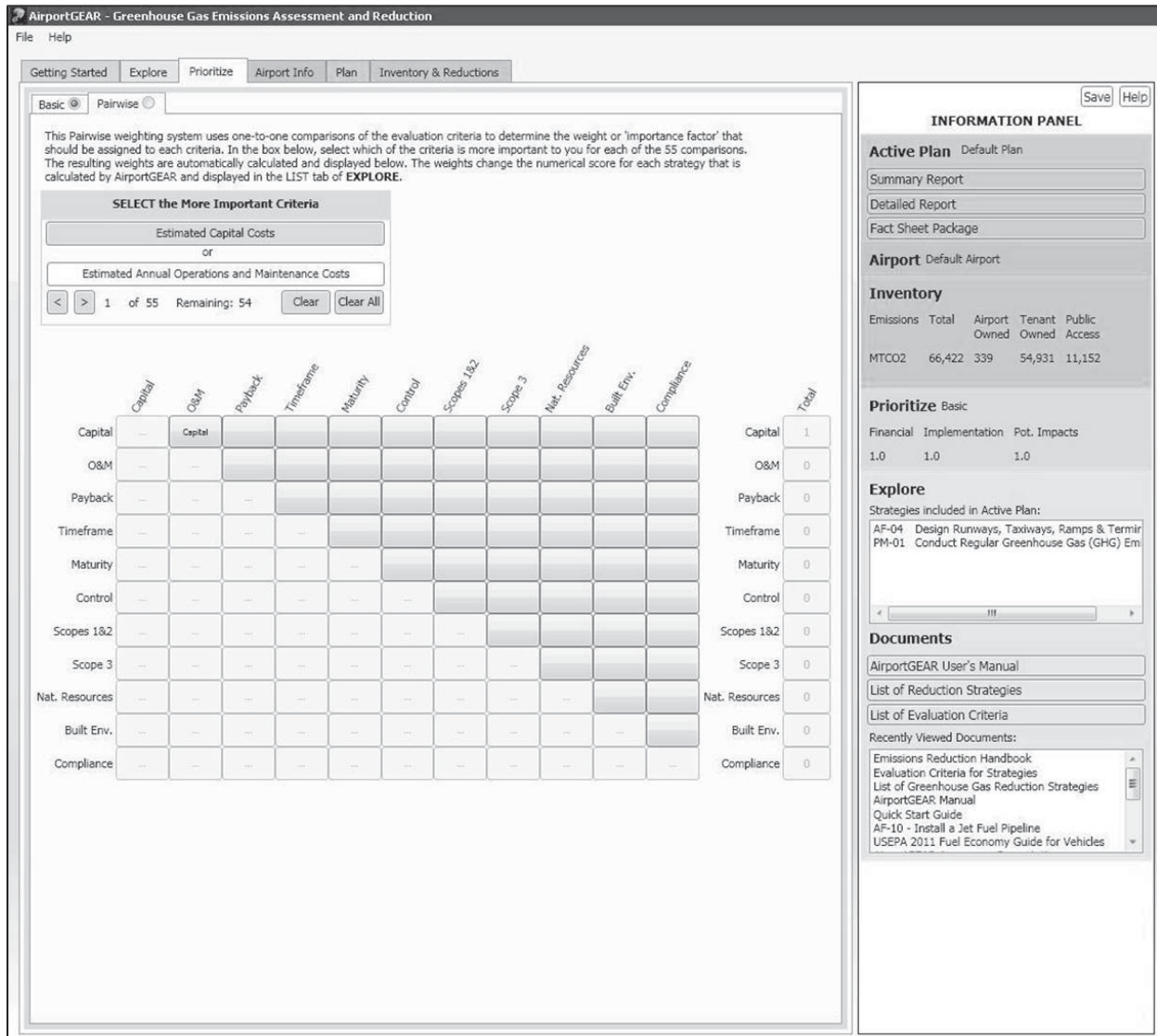
Figure III-8.   Screenshot for the PAIRWISE tab in PRIORITIZE.

AIRPORT INFO

Users can enter airport-specific information to determine which strategies are most applicable to their facility or project. The custom information entered by users is used to eliminate strategies that are not applicable to their airport. The strategies are eliminated from view in **EXPLORE.** Figure III-9 depicts the screenshot for **AIRPORT INFO.**
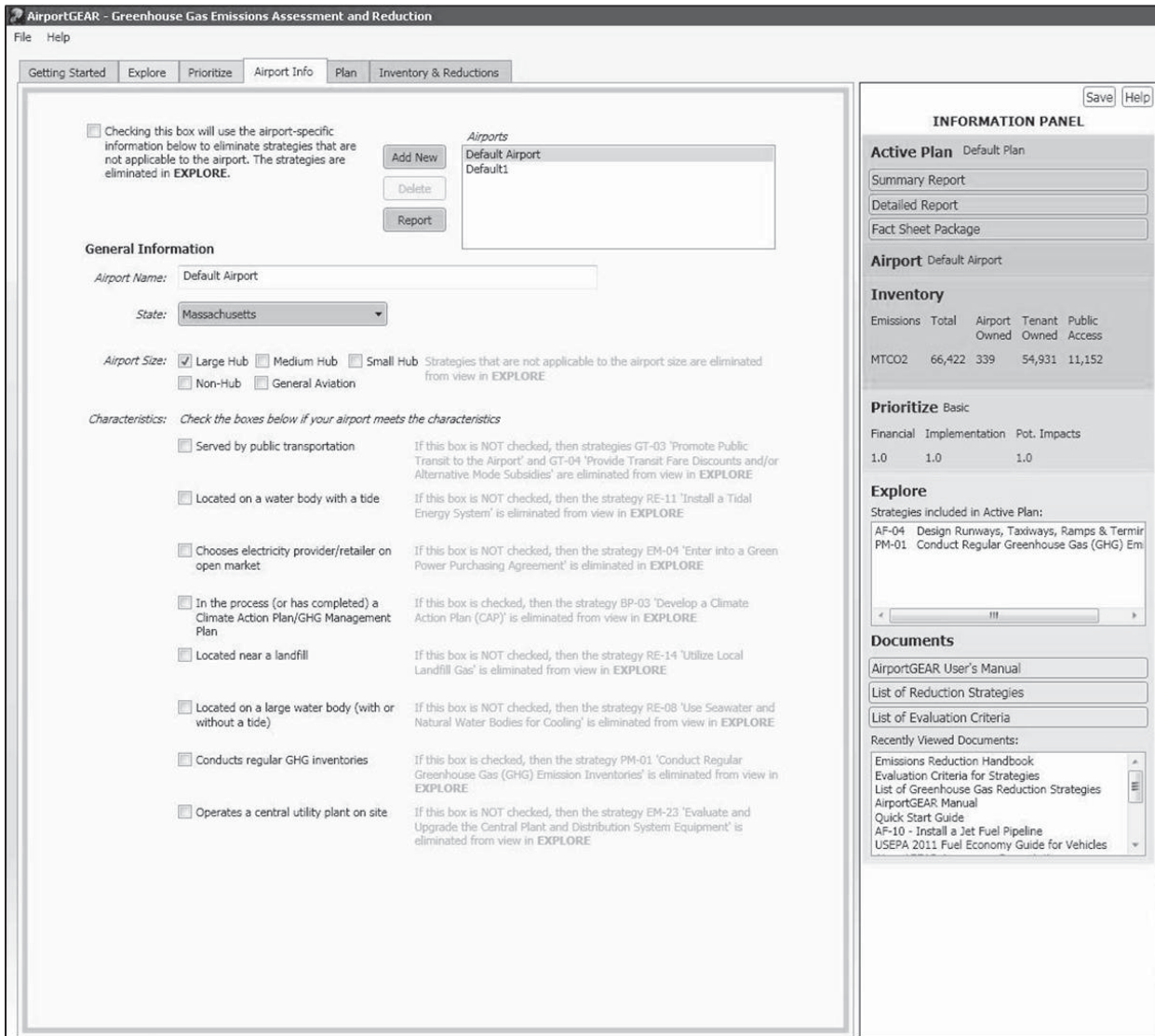
Figure III-9.   Screenshot for AIRPORT INFO.

PLAN

Users can group strategies for a specific facility or project and store their choices in written reports. Figure III-10 depicts the screenshot for **PLAN.**
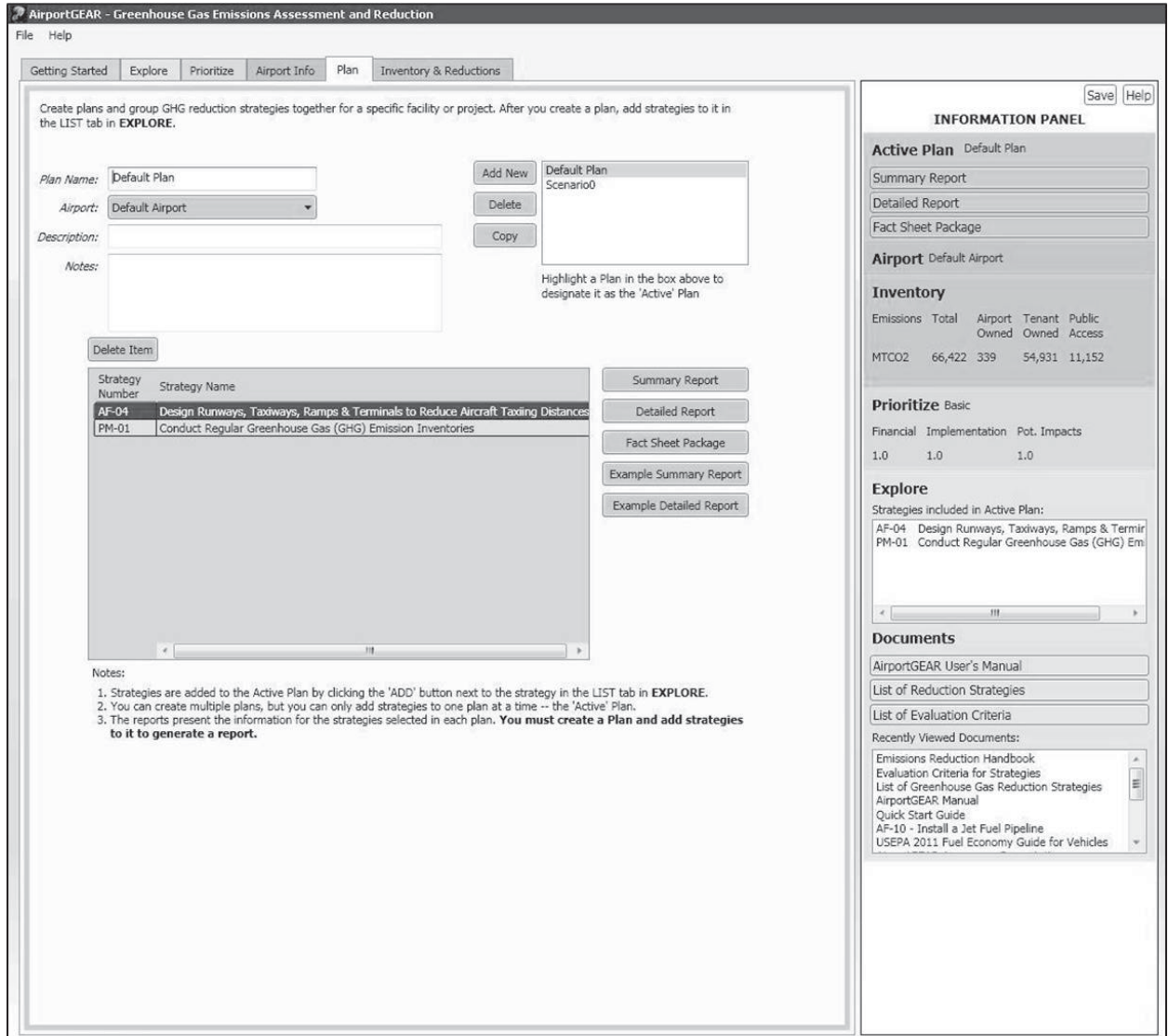
Figure III-10.   Screenshot for PLAN.

INVENTORY & REDUCTIONS

Users can calculate potential emission reductions for each of the selected strategies and see how those reductions impact their greenhouse gas inventory. The comparison of the greenhouse gas inventory before and after implementation of the selected strategies is presented in the written reports that are organized in **PLAN.** Figures III-11 and III-12 depict the screenshots for **INVENTORY & REDUCTIONS.**
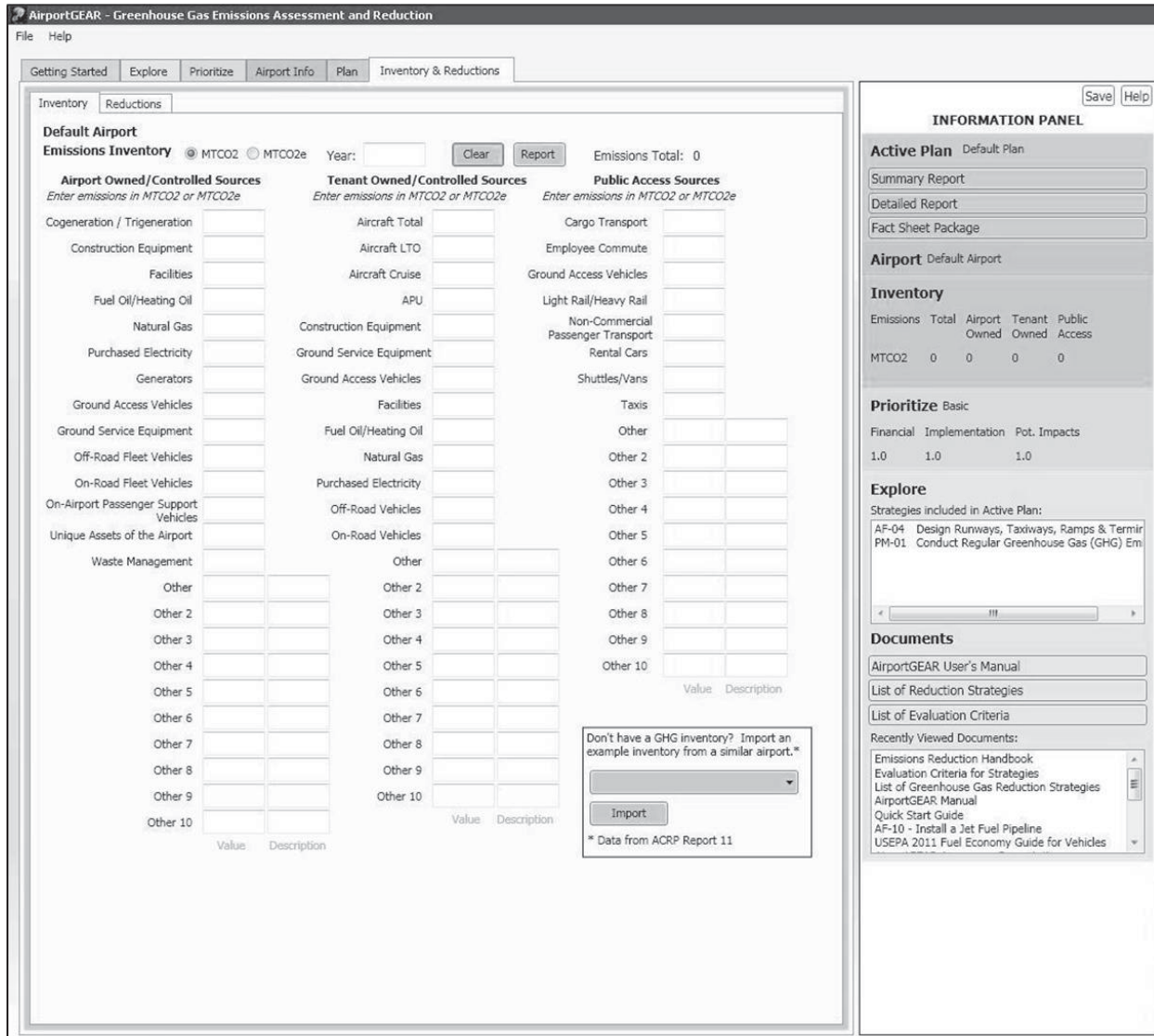
Figure III-11.   Screenshot for the INVENTORY tab in INVENTORY & REDUCTIONS.
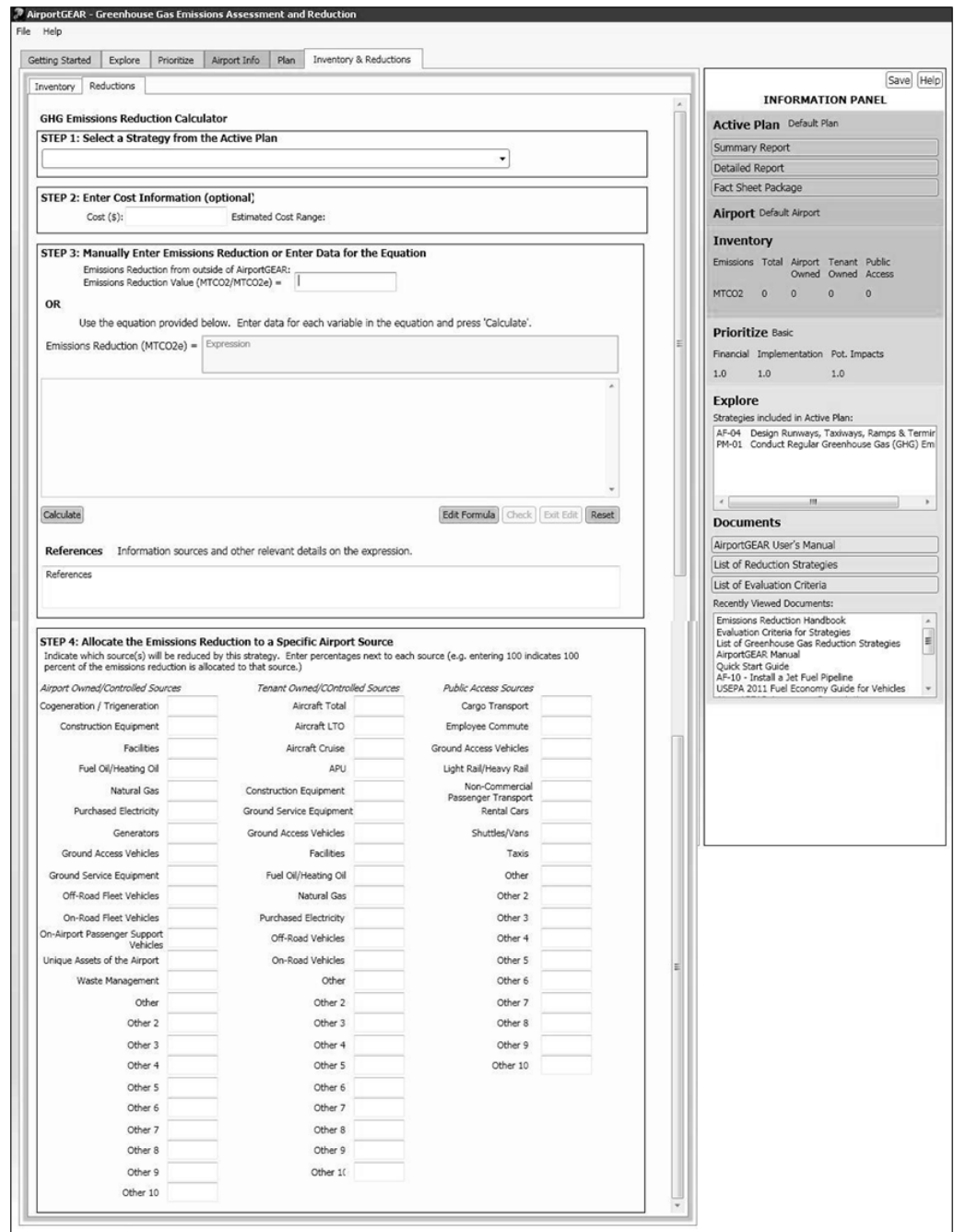
Figure III-12.   Screenshot for the REDUCTIONS tab in INVENTORY & REDUCTIONS.

The AirportGEAR User's Manual is included as Appendix B and provides greater detail concerning how to use AirportGEAR to evaluate, prioritize, and select greenhouse gas reduction strategies for a specific airport.

III.3.2 Examples of Uses of AirportGEAR

The features of AirportGEAR are designed to assist airport operators in reducing greenhouse gas emissions whether they are in the initial stages of learning about greenhouse gas mitigation or already have greenhouse gas emission reduction activities under way. Airport operators at

different levels of progress in their greenhouse gas mitigation will find different AirportGEAR features more useful to them depending on their current and planned activities. Examples of how users with the following needs can use AirportGEAR are described in this subsection:

- I'm Curious About Greenhouse Gas Mitigation.
- I'm Starting to Plan for Greenhouse Gas Emission Reductions.
- I'm Interested in Greenhouse Gas Emission Reduction Strategies for a Particular Project.
- I'm Interested in Greenhouse Gas Emission Reduction Strategies for a Particular Operation.
- I'm Interested in Greenhouse Gas Emission Reduction Strategies that Give the "Best Bang for the Buck."
- I'm Ready to Fund Greenhouse Gas Emission Reduction Activities.
- I Have to Meet a Greenhouse Gas Emission Reduction Target.
- I'm Developing or Updating a Climate Action Plan.

I'm Curious About Greenhouse Gas Mitigation

An airport operator that is curious about greenhouse gas emission reduction strategies but does not plan to actively pursue mitigation initiatives will likely find the most use in the **EXPLORE** feature, where the complete list of 125 greenhouse gas reduction strategies can be browsed, sorted, and filtered. Key references are also included in the LIBRARY tab of the **EXPLORE** feature that offer background information on greenhouse gas reduction in general. The **GETTING STARTED** feature also includes information on how to use AirportGEAR that may be useful.

I'm Starting to Plan for Greenhouse Gas Emission Reductions

An airport operator that is in the beginning stages of planning for greenhouse gas emission reductions for a facility or a project and is tasked with developing a list of potential reduction strategies will likely find the most use in the **EXPLORE** feature. Using **EXPLORE,** the airport operator can determine which of the 125 reduction strategies warrant further discussion and exploration. Users can create a plan in the **PLAN** feature, add strategies they are interested in to the plan from the LIST tab in **EXPLORE,** and print the "Summary Report" and the "Fact Sheet Package" from **PLAN** to facilitate discussions. The Fact Sheets, also located in the LIBRARY tab of **EXPLORE,** can support subsequent discussions.

I'm Interested in Greenhouse Gas Emission Reduction Strategies for a Particular Project

An airport operator that would like to integrate greenhouse gas emission reduction strategies into a specific project will likely find the most use in the **EXPLORE** feature. Using the SEARCH tab in **EXPLORE,** the airport operator can use the check boxes at the bottom to select Project Type(s) (i.e., planning, design, and/or construction) and Functional Area(s) of the airport (e.g., buildings, pavement, rental cars, baggage, signage, parking, etc.). Then, the user can click on the "Show Results" button at the top to view the list of strategies that is applicable to that Project Type and Functional Area(s). Users then can create a plan in the **PLAN** feature, add strategies they are interested in to the active plan from the LIST tab in **EXPLORE** by clicking the "ADD" button, and print the "Summary Report" and the "Fact Sheet Package" from **PLAN** to facilitate discussions and decision-making activities.

I'm Interested in Greenhouse Gas Emission Reduction Strategies for a Particular Operation

An airport operator that would like to integrate greenhouse gas emission reduction strategies into a specific operation will likely find the most use in the **EXPLORE** feature. Using the SEARCH tab in **EXPLORE,** the airport operator can use the check boxes at the bottom to select Project Type(s) (i.e., airside operations, landside operations, or administrative) and Functional Area(s) of the airport (e.g., buildings, pavement, rental cars, baggage, signage, parking, etc.).

Then, the user can click on the "Show Results" button at the top to view the list of strategies that is applicable to that operation and Functional Area(s). Users then can create a plan in the **PLAN** feature, add strategies they are interested in to the active plan from the LIST tab in **EXPLORE** by clicking the "ADD" button, and print the "Summary Report" and the "Fact Sheet Package" from **PLAN** to facilitate discussions and decision-making activities.

I'm Interested in Greenhouse Gas Reduction Strategies that Give the "Best Bang for the Buck"

An airport operator that is tasked with reducing greenhouse gas emissions and has limited resources will likely find the most use in the **AIRPORT INFO, PRIORITIZE, EXPLORE,** and **PLAN** features:

- In the **AIRPORT INFO** feature, the user can enter airport-specific information to eliminate strategies that are not applicable to that facility. The strategies are eliminated from view in **EXPLORE.**
- The user can go to the SEARCH tab in **EXPLORE** and set the sliders to show the least expensive strategies (e.g., one or two $ icons) and the greatest greenhouse gas benefits (e.g., two or three smoke stacks for Scopes 1 & 2 and Scope 3). Afterward, the user can click on the "Show Resulting Strategies" button to present the list of strategies that match those criteria. This method can be used with or without user-defined inputs in **PRIORITIZE** and **AIRPORT INFO.**
- In the **PRIORITIZE** feature, the user can "weight" the evaluation criteria related to cost (i.e., estimated capital cost, estimated operation and maintenance costs, and estimated payback period) and greenhouse gas reduction potential higher than the other evaluation criteria. The weighting will be reflected in the numerical score that is calculated by AirportGEAR for each strategy. The numerical score is presented in the LIST tab in **EXPLORE.**
- After prioritization of the evaluation criteria, the user can go to the LIST tab in the **EXPLORE** feature and sort the strategies to show those with the lowest costs or the highest numerical score by clicking on the header names (e.g., clicking on "Total Score" will sort the strategies by ascending or descending score values). Strategies with the highest scores are the most desirable.
- In **PLAN,** users can create a plan to organize the strategies they are interested in. From the LIST tab in **EXPLORE,** users can select the strategies that fit the airport's operating conditions and resources and add them to the active plan by clicking the "ADD" button. Following, users can print the "Summary Report" and the "Fact Sheet Package" from **PLAN** to facilitate discussions and decision-making activities.

I'm Ready to Fund Greenhouse Gas Emission Reduction Activities

An airport operator that is ready to select greenhouse gas emission reduction strategies for consideration for funding and implementation will likely find the most use in **AIRPORT INFO, PRIORITIZE, EXPLORE,** and **PLAN:**

- In the **AIRPORT INFO** feature, the user can enter airport-specific information to eliminate strategies that are not applicable to that facility. The strategies are eliminated from view in **EXPLORE.**
- In the **PRIORITIZE** feature, the user can "weight" the evaluation criteria to reflect custom needs and preferences. The weighting will be reflected in the numerical score that is calculated by AirportGEAR for each strategy and displayed in the LIST tab of **EXPLORE.** The numerical scores can be used to prioritize the strategies (e.g., the highest scores are the most desirable). Clicking on the "Total Score" header in the LIST tab in **EXPLORE** will sort the strategies by ascending or descending score values.
- **EXPLORE** allows the user to evaluate and select the strategies that are most appropriate for a facility or project and organize them in a plan. For example, an airport operator may develop

a plan focused on energy management and a plan focused on airfield design to support different decision-making activities within the organization.

- In **PLAN,** users can create a plan(s) to organize the strategies they are interested in. From the LIST tab in **EXPLORE,** the user can select the strategies that fit the airport's operating conditions and resources and add them to the active plan by clicking the "ADD" button. Following, users can print the "Summary Report" and the "Fact Sheet Package" from **PLAN** to facilitate discussions and decision-making activities.

I Have to Meet a Greenhouse Gas Emission Reduction Target

An airport operator that has made a commitment to a specific greenhouse gas emission reduction target (e.g., 80% reduction compared to 2000 levels) will likely find the most use in the **AIRPORT INFO, PRIORITIZE, EXPLORE, INVENTORY & REDUCTIONS,** and **PLAN** features:

- In the **AIRPORT INFO** feature, the user can enter airport-specific information to eliminate strategies that are not applicable to that facility. The strategies are eliminated from view in **EXPLORE.**
- In the **PRIORITIZE** feature, the user can "weight" the evaluation criteria to reflect custom needs and preferences. The weighting will be reflected in the numerical score that is calculated by AirportGEAR for each strategy and displayed in the LIST tab of **EXPLORE.** The numerical scores can be used to prioritize the strategies (e.g., the highest scores are the most desirable). Clicking on the "Total Score" header in the LIST tab in **EXPLORE** will sort the strategies by ascending or descending score values.
- Using **EXPLORE,** the user can evaluate and select those strategies that are most appropriate for a facility or project and add them to a plan. Strategies can be added to the active plan by clicking the "ADD" button next to the strategy name in the LIST tab in **EXPLORE.**
- In the **INVENTORY & REDUCTIONS** feature, the user can enter the greenhouse gas inventory for the baseline year. The user can also estimate the amount of greenhouse gas emission reduction that may occur by entering specific data regarding implementation of each of the selected strategies. For example, for energy management strategies that reduce electricity use, the user can enter the estimated amount of electricity that will be saved from implementing the strategy and then calculate the equivalent amount of greenhouse gas emissions that will be reduced.
- In **PLAN,** the user can create a plan(s) to organize the strategies they are interested in. From the LIST tab in **EXPLORE,** the user can select the strategies and add them to the active plan by clicking the "ADD" button. Then, the user can print the "Detailed Report" and the "Fact Sheet Package" from **PLAN** to facilitate discussions and decision-making activities. The report will summarize the key information about each of the selected strategies, including the results of the calculations, and compare the baseline greenhouse gas inventory to the inventory that would result after implementation of the selected strategies. This comparison will allow the airport operator to estimate the amount of reduction that can be achieved and gauge whether it will result in meeting the targeted goal.

I'm Developing or Updating a Climate Action Plan

An airport operator that is developing or updating a Climate Action Plan will likely find the most use in the **AIRPORT INFO, PRIORITIZE, EXPLORE, CALCULATE,** and **PLAN** features.

- In the **AIRPORT INFO** feature, the user can enter airport-specific information to eliminate strategies that are not applicable to that facility. The strategies are eliminated from view in **EXPLORE.**
- In the **PRIORITIZE** feature, the user can "weight" the evaluation criteria to reflect custom needs and preferences. The weighting will be reflected in the numerical score that is calculated by AirportGEAR for each strategy and displayed in the LIST tab of **EXPLORE.** The numerical

scores can be used to prioritize the strategies (e.g., the highest scores are the most desirable). Clicking on the "Total Score" header in the LIST tab in **EXPLORE** will sort the strategies by ascending or descending score values.

- Using **EXPLORE,** the user can evaluate and select those strategies that are most appropriate for a facility or project and add them to a plan. Strategies can be added to the active plan by clicking the "ADD" button next to the strategy name in the LIST tab in **EXPLORE.**
- In the **INVENTORY & REDUCTIONS** feature, the user can enter the greenhouse gas inventory for the baseline year. The user can also estimate the amount of greenhouse gas emission reduction that may occur by entering specific data regarding implementation of each of the selected strategies. For example, for energy management strategies that reduce electricity use, the user can enter the estimated amount of electricity that will be saved from implementing the strategy and then calculate the equivalent amount of greenhouse gas emissions that will be reduced.
- In **PLAN,** users can create a plan(s) to organize the strategies they are interested in. From the LIST tab in **EXPLORE,** the user can select the strategies and add them to the active plan by clicking the "ADD" button. Then, users can print the "Detailed Report" and the "Fact Sheet Package" from **PLAN** to facilitate discussions and decision-making activities. The report will summarize the key information about each of the selected strategies. The plan(s) can be used for discussions and decision-making activities to determine which strategies can be funded and implemented or to report projected greenhouse gas emission reductions in the Climate Action Plan.

Greenhouse Gas Accounting Principles and Other Considerations

Understanding the common greenhouse gas accounting principles, unique characteristics of the airport, and airport's inventory processes is imperative to selecting appropriate greenhouse gas reduction strategies. This section of the Handbook identifies the following:

IV.1 Sources of Airport-Related Greenhouse Gas Emissions
IV.2 Boundaries of Airport Greenhouse Gas Inventories
IV.3 Mitigation versus Offsetting
IV.4 Relationship between Greenhouse Gas Reduction and Other Airport Documents, Processes, and Programs
IV.5 Importance of Coordination with Tenants and Other Stakeholders
IV.6 Regulations and Voluntary Reporting and Mitigation

These sections provide an important foundation for understanding the information presented in the Handbook, AirportGEAR, and the individual Fact Sheets. The information presented in Sections IV.1 and IV.2 is summarized from *ACRP Report 11: Guidebook on Preparing Airport Greenhouse Gas Emissions Inventories.*

IV.1 Sources of Airport-Related Greenhouse Gas Emissions

ACRP Report 11: Guidebook on Preparing Airport Greenhouse Gas Emissions Inventories identifies the basic range of sources of greenhouse gas emissions at airports. While every airport is different, and because of the unique sources that may operate at any one individual airport, airport operators should carefully consider the boundaries of their operation and the types of traditional activities at the airport as well as activities unique to that airport.

IV.1.1 Traditional Greenhouse Gas Emission Sources at Airports

Traditional greenhouse gas emission sources encompass the activities found at the majority of airports and include the following:

- Aircraft operations, including auxiliary power units (APUs)
- Ground support equipment—the ground vehicles that service aircraft
- Stationary source emissions
  - Facility/building power (electricity, natural gas, oil)
  - Emergency generator fuel use
  - Refrigerants

- Surface vehicle travel
  - Airport service equipment/fleet vehicles (i.e., snow removal, aircraft rescue and fire fighting, etc).
  - Airport employee commute and administrative travel
  - Tenant support ground travel and employee commute
  - Public ground travel
- Airport recycling
- Construction and maintenance project activities

As is discussed later, the accounting of greenhouse gas emissions assigns the designation Scope 1, 2, or 3 to each source category, based on the ownership and control of the source discussed later in Section IV.2.

IV.1.2 Non-traditional Greenhouse Gas Emission Sources at Airports

Many airports have non-traditional sources that operate within the airport that may also warrant consideration in the inventory or emission reduction activities. Section IV.2 identifies considerations of the boundaries of a greenhouse gas inventory that warrant consideration. Non-traditional activities, or activities that may not occur at every airport, could consist of the following:

- Aircraft maintenance and/or aircraft manufacturing
- Farming of residual airport-owned lands
- Natural resources extraction (e.g., mining, drilling, etc.) on airport-owned lands
- Commercial development use of airport lands

The following section identifies the boundaries of the inventory relative to the types of sources that typically occur at an airport.

IV.2 Boundaries of Airport Greenhouse Gas Inventories

As noted in the previous section, a wide variety of sources of greenhouse gases occur at an airport. Many of the sources of emissions are not owned by the airport operator, and there may be many owners of similar sources at one airport (e.g., multiple airlines, multiple ground transportation service providers). The accounting of greenhouse gas emissions in inventories relies on a set of boundaries that relate to the authority of the inventorying entity over the sources reported. These boundaries are noted by categorizing the emissions (Scope 1, Scope 2, and Scope 3) and depend on the organization represented in the inventory. The boundaries relate to organizational structure and operational boundaries.

IV.2.1 Organizational Structure

Organizational structure reflects the control through ownership, legal agreements, joint ventures, etc. of specific sources. In the case of most airports, the organization boundaries typically represent the following:

- A city or county department or division (i.e., aviation department)
- An airport authority (which is typically a separate political entity)
- A port district (for which the airport may be a single focus or there may be multiple divisions)
- A department of a state (i.e., state transportation department, aviation division)

When considering organizational source control, thought must be given to activities supplied by sister entities to avoid double counting. For instance, in a city organization, some police and

fire departments provide services to the airport. If the inventory is specific to the airport, only the vehicles and activities owned by the airport would be included in the airport inventory. The city police and/or fire department inventory would include the airport police and fire activities, if that other department owned the sources (i.e., vehicles).

IV.2.2 Operational Boundaries

Once an entity has determined its organizational boundaries in terms of the operations that it owns or controls, it then sets its operational boundaries. When developing a greenhouse gas inventory, emissions are often categorized as Scope 1, 2, or 3. Each scope of emissions indicates the relative amount of control that the airport has over the sources of emissions and, potentially, how the airport may be regulated. The WRI adopted the terms "Scope 1," "Scope 2," and "Scope 3," which have become standards for inventories and are defined as follows:

- Scope 1 emissions are from sources that are owned and controlled by the entity. For example, emissions from combustion in airport-owned boilers, furnaces, vehicles, etc. are considered to be Scope 1. Scope 1 sources for an airport operator typically include airport service/fleet vehicles, certain stationary sources, airport-owned aircraft, and refrigerant use by the airport operator. Existing and emerging regulations often focus on Scope 1 emissions.
- Scope 2 emissions are from the electricity or steam purchased by the airport. In this case, the practice is to associate electrical and steam purchases to the entity that receives the bill, which may or may not be the consumer. Therefore, if the airport operator receives the electrical and steam bill and then later invoices its tenants, the airport operator reports all airport electrical consumption as Scope 2. If tenants are directly billed by the utility provider, the electrical consumption of the tenant is reported as Scope 3. Scope 2 emissions are often included in voluntary reporting registries.
- Scope 3 emissions are a consequence of the activities of the entity, but occur at sources owned or controlled by another party. At an airport, these emissions would be associated with tenant aircraft operations, tenant ground support equipment, tenant ground vehicle movement, and public vehicular access to and from the airport. Scope 3 emissions can account for up to 90% to 95% of greenhouse gas emissions in an airport's inventory. Airports may influence Scope 3 emissions but cannot directly control them.

Because airports may wish to reflect the influence that they have over emissions of some of their tenants' activities, inventories may be structured in a way that captures and identifies that influence. These structures maintain the Scope 1/2/3 designations but then organize sources according to influence and control often called "groups" or "categories." Table IV-1 shows an example inventory as reported in *ACRP Report 11* showing three groups reflecting influence and control.

As Table IV-1 shows, some airport operators have the ability to control the movement of ground vehicles on airport roadways, but in some cases may not be able to dictate the types of ground vehicles. Other airports have no control over ground access use. Therefore, for those airports that wish to reflect their control of airport roadway use, the controllable emissions would be separated from the uncontrollable emissions, but both would be labeled as Scope 3. This type of reporting correctly notes the scope but then also identifies the influence that the entity may have over other sources. As a result, some airports have created three or more categories of emissions, reflecting the degree of control that the airport has over Scope 3 sources. In the case of the example in Table IV-1, three categories are shown (airport owned or controlled, tenant owned or controlled, and public owned or controlled).

Table IV-1.   Example of airport-wide emissions inventory.

User/Source Category	WRI Scope	Current Emissions (metric tons CO2e)
A: Airport Operator Owned/Controlled		
Electrical consumption	2	41,400
Natural gas & heating oil	1	1,000
Airport fleet vehicles	1	10,000
Ground access vehicles (all vehicles on airport roads)	1/3	14,567
Total Airport Operator Owned/Controlled		*66,967*
B: Airlines/Tenants/Aircraft Operator Owned/Controlled		
Aircraft		
Ground	3	140,000
Ground to 3,000 ft	3	207,000
Above 3,000 ft	3	1,890,000
Subtotal (Aircraft)		*2,237,000*
APUs	3	30,000
Ground support equipment	3	6,540
Ground access vehicles	3	1,278
Stationary sources/facility power	3	0
Total Airlines/Tenants/Operator Owned/Controlled		*2,274,818*
C: Public Owned/Controlled		
Public vehicles	3	235,467
Shuttles and private vehicles	3	1,467
Total Public Owned/Controlled		*236,934*
Total Categories A–C		**2,578,719**
Waste recycling		(852)
Grand Total Emissions		**2,577,867**

Source: Modified from *ACRP Report 11* (Table 1-1)

IV.3 Mitigation vs. Offsetting

One important element of capturing and accounting for emissions is the recognition and explanation of changes in source emissions over time and the actions and strategies designed to reduce emissions. Some refer to this as "taking credit" for an emission reduction. However, "credit" is a term of art used in criteria pollutant emissions evaluations. Credits can refer to many actions, including:

- **Program Compliance Credit:** Gaining recognition for an action by a participant in a program for purposes of achieving compliance with the goals of the program.
- **State Implementation Plan (SIP) Credit:** A form of program compliance credit, where the emission reductions enable criteria pollutant SIP goals to be achieved and are recognized by the USEPA.
- **Marketable Credit:** A commodity reflecting an emissions reduction that can be traded or sold. Marketable credits may or may not enable program compliance. For greenhouse gases, these are often also referred to as offsets.

Because of its other uses, "credit" should be used with caution in reference to greenhouse gas. Mitigation and offsetting are terms used for greenhouse gas. Actions and strategies that the airport operator has taken to reduce emissions from sources it owns or controls reflect mitigation. Offsetting reflects the actions or strategies taken to reduce emissions from sources that are not owned or controlled by the sponsor, and include the purchase of commercially available emission reduction credit(s) for actions on- or off-airport.

It was beyond the scope of *ACRP Report 11* to address how mitigation and offsetting were to be reflected in an airport's emissions inventory. However, a few airports have embraced mitigation planning in the presentation of their inventories. The inventory format shown in Table IV-1 would form the basis for further reporting mitigation or offsets. To illustrate the emission reduction, a supplemental table should be created to note what the emissions would have been if the action had not been taken. Table IV-2 provides an example of how mitigation can be captured in the inventory. The supplemental table would present a condition referred to as the Business as Usual (BAU) condition, or the without-mitigation-or-offset information. BAU should reflect the condition that would be expected in a specific timeframe as if the mitigation or offsetting action had not occurred. Often the BAU requires projections or estimates that reflect a linear projection of emissions based on the ratio of activity to a known emission level. Then a comparison of BAU emissions to the actual emissions indicates a change. In many cases, the emission change can be directly traced to an action taken by the airport. In other cases, the change is due to a change by another party, particularly a party that owns or controls the source (e.g., an airline or the FAA).

As Table IV-2 shows, to provide transparency of the emissions change, the inventory should note the emissions with and without the action that was taken, so that it is clear how a declared emissions change occurred.

IV.4 Relationship Between Greenhouse Gas Reduction and Other Airport Documents, Processes, and Programs

While emission reduction actions should be coordinated with the airport's inventory, not every airport has or would be expected to generate a greenhouse gas emissions inventory. Many other airport processes and programs will influence when, how, and where airports consider emission reduction strategies. Each of these processes or programs was considered in the review of the emission reduction strategies documented in Section II. These activities could include the following:

- Financial issues and grant assurances
- Planning and development, including Capital Improvement Projects
- Airport energy management and operational practices

The following subsections briefly discuss these activities.

IV.4.1 Financial Issues and Grant Assurances

With specific exceptions, most US airports are owned by units of local government (cities and counties). Some states also own and operate airports, and some governmental entities have created authorities to oversee airports, such as airport authorities or port districts. Airport ownership itself would not affect the mitigation practices other than reflecting the ownership and control of the sources, noted in Section IV.2.

Aviation is a highly regulated industry, with considerable financial and operational oversight. Federal statutes and rules typically take priority over (and in many cases preempt) state and local regulation. This is particularly true in the case of airports, which, in addition to being closely monitored by the FAA for safety and other purposes, are highly dependent on FAA funding for capital improvements. In implementing emission reduction strategies, airport operators must comply with a complex regulatory scheme that is overseen by the FAA but also subject

Table IV-2. Example inventory that identifies mitigation.

User/Source Category	WRI Scope	Emissions (Metric Tons CO2e)		
		Business as Usual	Actual with Mitigation	Change
Airport Operator Owned/Controlled				
Electrical consumption	2	41,400	41,300	(100)
Natural gas & heating oil	1	1,000	1,000	
Airport fleet vehicle	1	10,000	10,000	–
Ground access vehicles (all vehicles on airport roads)	1/3	14,567	14,567	–
Subtotal Airport Operator Owned/Controlled		*66,967*	*66,867*	*(100)*
Airlines/Tenants/Aircraft Operator Owned/Controlled				
Aircraft				
Ground	3	140,000	135,800	(4,200)
Ground to 3,000 ft	3	207,000	198,720	(8,280)
Above 3,000 ft	3	1,890,000	1,890,000	–
Aircraft Total		*2,237,000*	*2,224,520*	*(12,480)*
APUs	3	30,000	22,000	(8,000)
Ground support equipment	3	6,540	6,540	–
Ground access vehicles	3	1,278	1,278	–
Stationary sources/facility power	3	NA	NA	NA
Subtotal Airlines/Tenants/Operator Owned/Controlled		*2,274,818*	*2,254,338*	*(20,480)*
Public Owned/Controlled				
Public vehicles	3	235,467	164,827	(70,640)
Shuttles and private vehicles	3	1,467	1,467	–
Subtotal Public Owned/Controlled		*236,934*	*166,294*	*(70,640)*
Total Airport, Tenant, and Public Source Emissions		**2,578,719**	**2,487,499**	**(91,220)**
Waste recycling		(852)	(852)	–
Airport operator-purchased offsets		–	(1,000)	(1,000)
GRAND TOTAL AIRPORT-WIDE EMISSIONS		**2,577,867**	**2,485,647**	**(92,220)**
Mitigation Summary				
Airport operator-sponsored mitigation		See summary below		(78,740)
Airport operator-sponsored offsets		–	(1,000)	(1,000)
Emissions change due to activities by another party		Unknown		(12,480)
Airport Operator-Sponsored Mitigation Summary				
Implementation of gate PCA/400 Hz power				
= Change in APU use (aircraft APU fuel consumption)	3	30,000	22,000	(8,000)
= Project-related electrical consumption	2	41,400	41,700	+ 300
Subtotal				*(7,700)*
Building energy efficiency action (reduction effect)				
= Installation of energy efficient lighting main terminal	2	41,700	40,700	(1,000)
= Installation of energy efficient lighting Concourse E	2	40,700	40,300	(400)
Subtotal		*NA*	*NA*	*(1,400)*
Opening of light rail to airport terminal				
= Reduced public travel to airport on surface road	3	235,467	164,827	(70,640)
= Increase in airport electrical consumption	2	40,300	41,300	+ 1,000
Subtotal				*(69,640)*
Total Airport Operator-Sponsored Mitigation				**(78,740)**

Business as usual reflects emissions if emission reduction action(s) had not been implemented.

Actual emissions reflect actions that have been taken to reduce emissions.

NA: not applicable as both represent emissions from electrical and cannot be added.

to oversight laws (e.g., city and county ordinances) as well as the contracts between the airport operator and its tenants.

The Airport Improvement Program and its predecessor the Airport Development Aid Program (ADAP) have been notable sources of federal dollars at an average airport. An AIP grant to an airport can cover a substantial portion of the costs of improvements addressing airport safety, capacity, security, or environmental projects, at up to 95% of the project cost. Such grants require compliance with a list of 39 "grant assurances" as a condition. The other primary source of funds at larger commercial service airports is the Passenger Facility Charge, which has notable FAA oversight. The grant assurances not only apply to the federally funded improvements but also to all of an airport's operations, as acceptance of these funds designates the airport as a public use airport. Likewise, although some of these conditions have a limited term, others are perpetual. Thus, the requirements imposed by grant assurances are relevant to not only airport operators themselves but also their tenants and other users. These assurances can affect either how monies are collected and used or the types of programs that are in place.

The important grant assurances relevant to greenhouse gas emission reduction strategies include the following:

- Grant assurance 5 requires that the airport not sell, lease, or encumber any part of its title or other interests in the property.
- Grant assurance 16 requires conformity of the airport with plans and specifications. Specifically "any modification to the approved plans [Airport Layout Plans], specifications, and schedules shall also be subject to approval of the Secretary. . . ."
- Grant assurance 19 requires the airport to be operated at all times in "a safe and serviceable condition" and in accordance with the minimum standards.
- Grant assurance 22 requires that the airport must be available as an airport for public use on reasonable terms and without unjust discrimination to all types, kinds, and classes of aeronautical activities, including commercial aeronautical activities offering services to the public at the airport.
- Grant assurance 24 requires the airport to maintain a self-sustaining fee and rental structure.
- Grant assurance 25 requires airport revenues to be used only for aeronautical purposes.

The FAA can prohibit the airport operator from receiving AIP funds if the airport is found in violation of a grant assurance and does not bring itself into compliance.

Section II documents the evaluation criteria and information for strategies identified by this study. Reflected in that analysis of the individual emission reduction strategies was the potential for airport operators to become in conflict with grant assurances. *Airports are encouraged to consult the FAA concerning potential conflicts if strategies to reduce emissions are not currently part of their current operation.*

IV.4.2 Planning and Development, including Capital Improvement Projects

Once an airport has received federal funding, its facilities must then continue to conform to the currently approved Airport Layout Plan (ALP) per grant assurance 16. Planning at airports can take many forms, including a Master Plan, ALP Updates, Sustainability Plans, documentation under the National Environmental Policy Act (NEPA), and/or general mitigation planning. Guidance concerning airport development project planning is found in FAA Advisory Circular (AC) 150/5070-6B, *Airport Master Plans,* and other FAA Advisory Circulars. While the FAA has guidance concerning facility planning, airport operators are not required to follow a specific planning process, as that process can be tailored to local needs. However, airport facility layouts

are subject to airport design standards to ensure consistency and safety. These standards are defined through a number of Advisory Circulars, including AC 150/5300-13, *Airport Design.*

In analyzing the strategies documented by this project, a review of FAA Orders and Advisory Circulars was conducted. For instance, if an airport was undertaking planning for a replacement hangar, the tools developed for this project could be consulted concerning various facets associated with the administration, planning, design, construction, and operation of the replacement hangar.

Examples of how greenhouse gas emission reduction strategies might be reflected in airport planning and development could include the following:

- Climate Action or Sustainability Planning where broad-based policies for reducing emissions are being considered. The Handbook and AirportGEAR could be used to aid in identifying emission reduction actions or strategies for inclusion in those plans and how they might achieve goals and objectives in these plans.
- Project/Capital Improvement Project (CIP) Planning. As airports consider individual development projects, the Handbook and AirportGEAR can be used to illuminate issues, benefits, and costs associated with various strategies that could be embraced in the project.

IV.4.3 Airport Energy Management and Operational Practices

Airport energy management (AEM) activities can consist of planning and development activities or general facility management. Airport facilities use large amounts of energy. The terminal facilities—the facilities that host passengers using commercial service airports—are the largest consumers of airport energy (e.g., lighting, heating, ventilation, air conditioning, etc.). Because of this consumption and associated financial cost, some airport operators have reduced operating expenses by focusing on energy efficiency, considering both energy supply and energy consumption. Airports have initiated energy audits and in some cases have assigned job responsibilities to airport staff for energy management.

It is anticipated that the Handbook and AirportGEAR will be useful tools for airport staff and other parties interested in managing and conserving energy use associated with airport facilities.

IV.5 Importance of Coordination with Tenants and Other Stakeholders

Given that many of the largest sources of emissions at airports are controlled by tenants or affect emissions of tenants (see Table IV-3), airport operators are encouraged to coordinate with their tenants (1) to accurately inventory these sources and, (2) if seeking emission reductions, to

Table IV-3.   Distribution of emissions by ownership and control.

Airport	Airport Owned/Controlled	Tenant Owned/Controlled	Public Airport Access Owned/Controlled
ONT	1.5%	81.1%	17.4%
SAN	1.5%	92.3%	6.1%
SEA	1.4%	90.4%	8.0%
PDX	2.6%	88.4%	9.0%
LAX	1.7%	93.4%	4.9%
Aspen	2.6%	95.4%	2.0%
Hillsboro	0.5%	95.8%	3.6%
Van Nuys	0.9%	90.5%	8.6%

Source: Synergy Consultants, based on reports by the airports above.

coordinate and communicate with these parties concerning feasibility and cost-effective emission reduction actions.

Based on a few inventories prepared to date, the distribution of emissions based on ownership and control indicates that the airport operator can control a small portion of emissions associated with an airport (on average less than 3% of the total airport-related emissions). However, airport operators may be in a position of supporting the emission reduction of its tenants (i.e., airlines, aircraft operators, tenants, etc.) as well as the public that uses the airport. Therefore, this Handbook recommends that as airport operators consider plans to reduce greenhouse gas emissions, they coordinate with the tenants and public users.

There are an extensive number of example actions that airport operators can take to reduce emissions associated with their tenant and public activities. The example in Table IV-2 identifies two actions that were taken by the airport: one that affected emissions by the airlines using one of the concourses and another that reduced the public ground travel emissions. First, the installation of pre-conditioned air/400-hertz power at the gates reduced aircraft operator APU emissions (a Scope 3 emission), while slightly increasing airport electrical consumption (a Scope 2 emission). This action resulted in a net reduction in airport-wide emissions as shown.

Because the substantial majority of emissions at an airport (typically over 90% of total airport-related emissions) are owned and/or controlled by other parties (i.e., tenants and the public), airport operators are encouraged to work with these parties to identify and implement strategies that are mutually beneficial in reducing greenhouse gas emissions.

IV.6 Regulations and Voluntary Reporting and Mitigation

The Handbook and AirportGEAR can aid airport operators in complying with federal, state, and local regulations and emissions reporting and mitigation. This section of the Handbook discusses the regulations and requirements that were in place at the time of publication. Regulatory requirements are evolving and the airport operator should refer to current legislation. Potential future requirements are also included here as an example of the types of legislation that may be encountered, even though the information listed may be outdated shortly after publication. At the time of this publication, greenhouse gas mitigation activities are voluntary unless an airport has committed to mitigation measures as part of NEPA or state regulation, such as the California Environmental Quality Act (CEQA) or the Massachusetts Environmental Policy Act (MEPA).

IV.6.1 Current Regulations and Requirements

In December 2009, the USEPA Administrator signed two important greenhouse gas findings:

- **Endangerment Finding:** The Administrator found that the current and forecast concentrations in the atmosphere of six key greenhouse gases threaten the public health and welfare of current and future generations.
- **Cause or Contribute Finding:** The Administrator found that the combined emissions of greenhouse gases from new motor vehicles and new motor vehicle engines contribute to the greenhouse gas pollution that threatens public health and welfare.

While these findings themselves do not place any regulatory or mitigation requirements upon airport operators and airport-related activities, under current US regulatory schemes, they would be a prerequisite to anticipated future controls on mobile sources. Subsequent to the findings, litigation has been brought seeking to overturn the findings.

As the USEPA moves to place regulatory requirements on greenhouse gas emissions, it has promulgated the following requirements:

- **Mandatory Reporting of Greenhouse Gases Rule.** The rule requires reporting of greenhouse gas emissions from specific sources—relatively large emitters and suppliers of fossil fuels or industrial greenhouse gases—to enable the USEPA to collect emissions data to inform future policy decisions. Under the rule, suppliers of fossil fuels or industrial greenhouse gases, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of greenhouse gas emissions are required to submit annual reports to the USEPA. In addition, facilities that operate certain sources, such as power generators, are automatically triggered to report under this rule, regardless of whether or not the threshold of 25,000 metric tons is exceeded.
- **Greenhouse Gas Emissions Standards and Fuel Economy Standards.** In April 2010, a final rule occurred covering model years 2012 through 2016 for passenger cars, light-duty trucks, and medium-duty passenger vehicles. The rule making requires these vehicles to meet an estimated combined average emissions level of 250 grams of carbon dioxide per mile, which is equivalent to 35.5 miles per gallon if the automobile industry were to meet this carbon dioxide level solely through fuel economy improvements.
- **Stationary Source Emissions (Prevention of Significant Deterioration/Title V Tailoring Rule).** Historically, stationary sources subject to certain emissions levels were subject to extensive regulations under the Clean Air Act New Source Review process. The USEPA refined these regulations to include greenhouse gases (i.e., tailoring rules). Starting in 2011, existing and new major sources of greenhouse gases, defined currently as those facilities emitting 75,000 metric tons of carbon dioxide equivalent or more per year, will be subject to Title V permitting, which could include restrictions and controls for greenhouse gas emissions.

At this time, it is expected that airlines, as corporate entities, are subject to these requirements and that approximately 10 to 20 US airports meet the requirements to report their greenhouse gas emissions, particularly those airports that have co-generation plants. A smaller subset of these airports may also be subject to the Title V Tailoring Rule. It is recommended that airport operators conduct a greenhouse gas inventory to determine if the regulatory thresholds of 25,000 metric tons for the Mandatory Reporting Rule and 75,000 metric tons for the Title V Tailoring Rule are exceeded.

Many of the airline partners operating at the nation's commercial service international airports are also subject to various emissions trading schemes (Europe and Australia). The most widely debated, given the amount of air traffic, is the European Union Emission Trading System (EU ETS). Under the EU ETS, implementation has occurred in stages, with the initial focus having been on the largest sources of emissions. These large emitters must monitor and annually report their carbon dioxide emissions. Starting January 1, 2012, aviation emissions will be subject to the EU ETS. For emissions in excess of their designated allowance, parties are required to either reduce emissions or purchase offsets. Litigation by US carriers was initiated over the EU ETS.

Prior to the 2009 USEPA actions and recent national level legislative efforts, many states and local communities, feeling that the federal government was not acting aggressively enough to address climate change, began to enact requirements to reduce greenhouse gases. Regional emissions reduction programs include the following:

- **Regional Greenhouse Gas Initiative (RGGI).** RGGI has established a cap-and-trade program affecting power plants with generating capacity of 25 MW or greater. A cap-and-trade system is an economic incentive program designed to reduce emissions by establishing a cap and enabling those who emit under the cap to sell their unused emissions allocation to those who are not able to reduce emissions in as cost effective a manner.

- **Western Climate Initiative (WCI).** WCI members agreed to jointly set a regional emissions target and establish a cap-and-trade program covering multiple economic sectors. The greenhouse gas emissions target for WCI members is 15% below 2005 levels by 2020, or approximately 33% below business-as-usual levels. The regional target is designed to be consistent with existing targets set by individual member states and does not replace these goals. A cap-and-trade program, beginning in 2012, will cover emissions from electricity and large industrial and commercial sources and, beginning in 2015, will cover emissions from transportation and other residential, commercial, and industrial fuel use.
- **Midwest Greenhouse Gas Reduction Accord (MGGRA).** MGGRA members agree to establish regional greenhouse gas reduction targets, including a long-term target of 60% to 80% below current emissions levels, and to develop a cap-and-trade system to meet the targets. Participants will also establish a greenhouse gas emissions reductions tracking system and implement other policies, such as low-carbon fuel standards, to aid in reducing emissions.

In addition, an extensive amount of state and local level emissions programs are in place and are too numerous to list.

IV.6.2 Potential Future Regulations and Requirements

At the time this Handbook was prepared, the primary federal, state, and local regulations governing greenhouse gases require one or more of the following:

- **Reporting of annual emissions over a designated threshold** (i.e., USEPA mandatory reporting rule requiring facilities generating more than 25,000 metric tons, WCI requiring reporting for facilities over 10,000 metric tons).
- **Increased production and use of renewable energy** where states and local government are seeking to use a greater quantity of renewable energy.
- **Emissions standards and/or fuel consumption/economy standards.** While federal level carbon dioxide emissions standards have not been promulgated, fuel consumption standards for surface vehicles have been promulgated not only on the federal level, but by several US states (California, Oregon, Washington) as well. In addition, meetings of the International Civil Aviation Organization have discussed various aircraft-related energy efficiency goals.
- **Mitigation.** Such requirements would principally arise from state or local climate action laws that seek to achieve an emissions reduction in the future relative to a past emission. However, international and some regional programs have adopted a cap-and-trade requirement that could require emissions reduction.

The following legislative efforts that are under deliberation in the US House of Representatives and Senate are indicative of these types of likely future requirements:

- The **American Clean Energy and Security Act of 2009** (H.R. 2454, also known as the Waxman-Markey Bill) as passed by the House would establish an economy-wide, greenhouse gas cap-and-trade system and critical complementary measures to help address climate change and build a clean energy economy. Except in unusual conditions, this act would not be expected to apply to airports unless airports are producing power or fuels or operate large stationary sources emitting more than 25,000 tons per year of greenhouse gases. The act would establish emission caps that would reduce emissions for all covered entities to 3% below their 2005 levels in 2012, 17% below 2005 levels in 2020, 42% below 2005 levels in 2030, and 83% below 2005 levels in 2050. The proposal also calls for regulations to limit black carbon emissions in the United States.
- The Senate's **Clean Energy Jobs and American Power Act of 2009** (S. 1733, known as the Kerry-Boxer Bill) would establish a cap-and-trade system to reduce greenhouse gases. Similar to the House Waxman-Markey Bill, this legislation would not be expected to directly affect

airports other than in cases where there are large stationary sources or where the airport generates power. The act would establish emission caps that would reduce emissions for all covered entities to 3% below their 2005 levels in 2012, 20% below 2005 levels in 2020 (lower than that of the House bill), 42% below 2005 levels in 2030, and 83% below 2005 levels in 2050.

- The **American Power Act** (Kerry-Lieberman Bill) is similar to the Waxman-Markey Bill as well as the Kerry-Boxer Bill with an economy-wide cap-and-trade system. Transportation fuels would be regulated at the point of distribution or import. In addition, this bill includes a "hard collar" on the price of carbon offsets.

- The **Carbon Limits and Energy for America's Renewal Act of 2009** (S. 2877, known as the Cantwell-Collins Bill) would require greenhouse gas emissions to be reduced by 20% relative to 2005 levels by 2020, 30% relative to 2005 levels by 2025, 42% relative to 2005 levels by 2030, and 83% relative to 2005 levels by 2050; these levels are similar to the Kerry-Boxer Bill. The act would require the Secretary of the Treasury to establish a program to reduce emissions by (1) placing a gradually declining limitation on the quantity of fossil carbon permitted to be sold and (2) requiring each first seller to surrender periodically a number of carbon shares equal to the quantity of covered carbon it produces or imports.

- The **American Clean Energy Leadership Act of 2009** (S. 1462), similar to H.R. 2454, contains extensive provisions concerning energy production, energy efficiency, renewable energy standards, etc.

- The **Clean Energy Act of 2009** (S. 2776) was introduced by Senators Webb and Alexander to promote investment and development of clean energy technologies, including nuclear power and other resources. It would result in the expenditure of $20 billion over 20 years to fund a series of loan guarantees; nuclear education and workforce training assistance; research into nuclear reactor lifetime extension; and the development of solar power, biofuels, and alternative power technologies.

- The **Clean Energy Partnerships Act of 2009** (S. 2729) would require the Secretary of Agriculture and the USEPA to establish (1) a program to govern the creation of credits from emission reductions; (2) an advisory committee to provide scientific and technical advice on the establishment and implementation of such an offset program; and (3) a carbon conservation program to provide incentives to implement projects that reduce greenhouse gas emissions through conservation easements, sequestration contracts, and timber harvest or grazing contracts. It would require the USEPA to establish a registry to record approved credits issued under such an offset program.

APPENDIX A

Fact Sheets

Technical information for 125 practical greenhouse gas emission reduction strategies is available on the attached CD-ROM in a PDF file.

APPENDIX B

AirportGEAR User's Manual

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TABLE OF CONTENTS (cont.)

INTRODUCTION

The purpose of this document is to describe the system requirements, prerequisites and dependencies, installation steps, and user's guide for AirportGEAR's features (**Airport G**reenhouse Gas **E**missions **A**ssessment and **R**eduction). AirportGEAR is designed to help airport operators select practical and cost-effective strategies to reduce greenhouse gas emissions for facilities and projects. You can enter custom information into AirportGEAR to determine which strategies are most applicable to your airport and to develop written plans for reducing your emissions. You can also calculate potential reductions in greenhouse gas emissions and see how they will impact your greenhouse gas inventory.

The ultimate goal of AirportGEAR is to create a written report, or series of reports, that summarizes the greenhouse gas emission reduction strategies that were selected for an airport using the evaluation techniques included in the tool. The written report(s) also include relevant technical information about each strategy, such as cost, emission reduction potential and impacts to a baseline greenhouse gas inventory. The report(s) are intended to facilitate discussions about greenhouse gas emission mitigation and to assist in decision-making activities related to greenhouse gas emission reduction at specific facilities or for specific projects.

This User's Manual includes the following information:

- Section 1 presents system requirements.

- Section 2 presents system prerequisites and dependencies.

- Section 3 presents a step-by-step installation guide.

- Section 4 presents a two-page Quick Start Guide for using AirportGEAR.

- Section 5 presents a detailed user's guide to AirportGEAR's features, including the purpose of each feature, how each feature works, and recommended uses of each feature.

SECTION 1: System Requirements

AirportGEAR is a stand-alone, desktop application written for the Windows XP operating system SP2 or later (Windows Vista, Windows 7). AirportGEAR is built on Microsoft's .NET 3.5 Framework which is included in the application installation package. Key System Requirements are described below.

Supported Operating Systems

- Windows 7

- Windows Server 2003 Service Pack 2

- Windows Server 2008

- Windows Vista Service Pack 1

- Windows XP Service Pack 2

Supported Architectures

- x86

- x64

Hardware Requirements

- Recommended Minimum: Pentium 1 GHz or higher with 512 MB RAM or more

- Minimum disk space:
  x86 – 600 MB
  x64 – 1.5 GB

SECTION 2: System Prerequisites and Dependencies

AirportGEAR includes several key prerequisites and dependencies.

- Windows Installer 3.1 or later

- Adobe (Acrobat) Reader version 9.0 – The AirportGEAR tool makes use of Adobe's PDF Reader control. Prior to running the AirportGEAR setup, users should verify the presence of Adobe Reader 9.0 or later. Users can obtain a free version from Adobe (http://get.adobe.com/reader/). Alternatively, a copy of the Adobe Reader installation file is included with the installation files.

- Microsoft's .NET 3.5 Framework (Client Profile) – The application was developed using the .NET 3.5 Framework. If the installation machine does not already have the .NET 3.5 Framework, AirportGEAR will install the minimum required "Client Profile" framework, a subset of the full .NET Framework. Installation of the .NET 3.5 Framework requires a mid-installation reboot on some machines.

- Microsoft ReportViewer 2008 – The application employs the Microsoft ReportViewer component to render Plan Reports. If the installation machine does not already have the Microsoft ReportViewer component, AirportGEAR will install the ReportViewer. No separate reboot is required to proceed.

SECTION 3: Installation Guide

The following steps detail the installation process.

3.1 Install Adobe Reader Prerequisite

AirportGEAR requires Adobe Reader 9.0 or later. Prior to running the AirportGEAR setup, users should verify the presence of Adobe Reader 9.0 or later. Users can obtain a free version from Adobe (http://get.adobe.com/reader/). Alternatively, a copy of the Adobe Reader installation file is included with the installation files.

The installation files include Adobe Reader which can be launched from the installation file AdbeRdr934_en_US.exe. Accept the default settings to install Adobe Reader. Below are screen shots presenting the installation process.
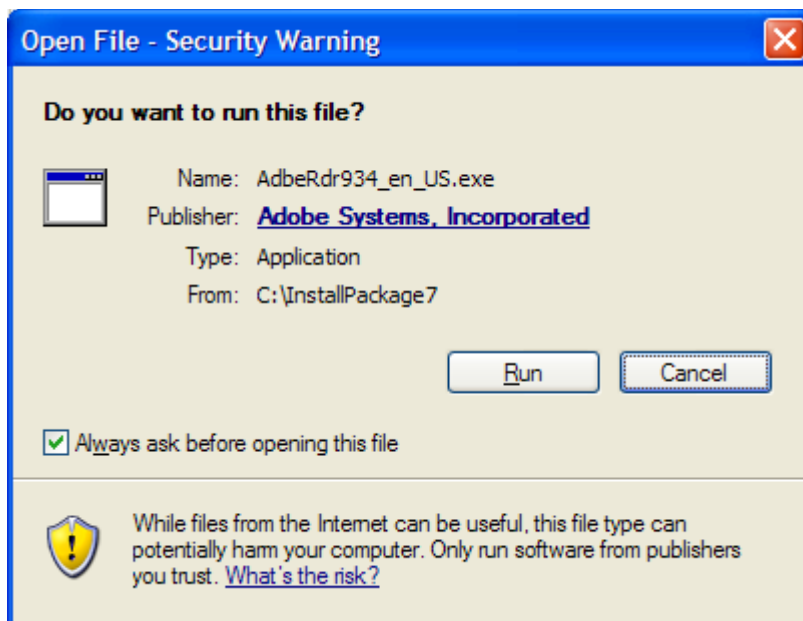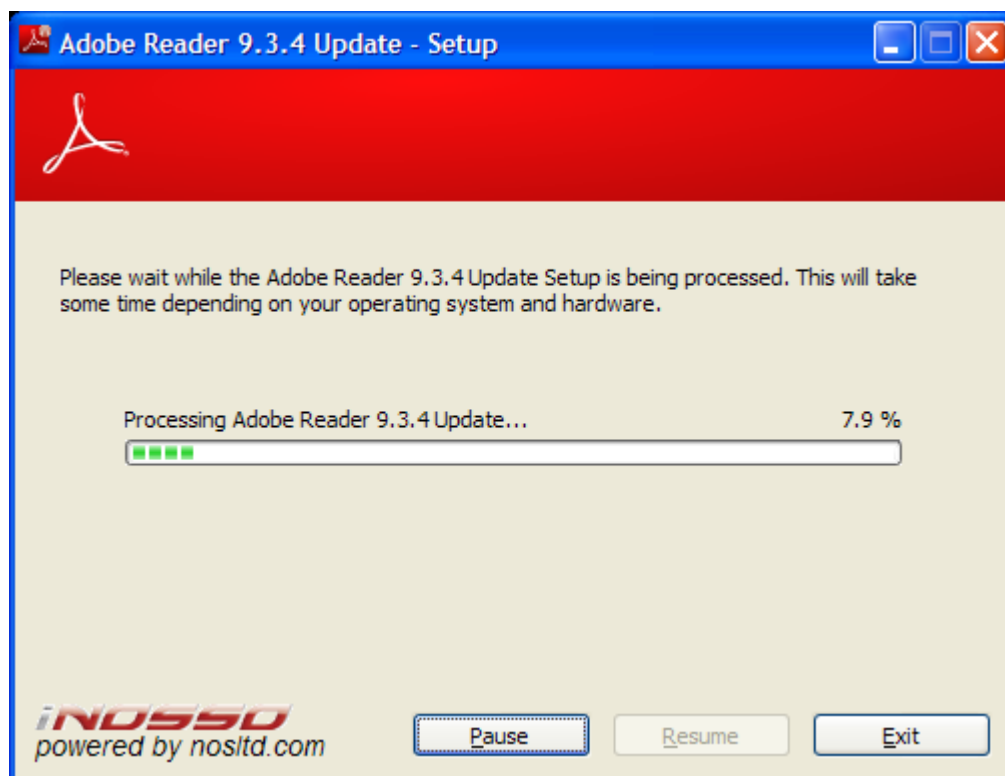
3.2 Install AirportGEAR

After verifying or installing the Adobe Reader prerequisites, you're ready to run the AirportGEAR setup installation file. Setup will check for AirportGEAR dependencies, which include the .NET 3.5 Framework (Client Profile) and the Microsoft ReportViewer (Microsoft Visual Studio 2008 Report Viewer). Depending on your system this may involve installation of AirportGEAR alone, or AirportGEAR in combination with one or both of the dependencies.

Follow the steps below to install AirportGEAR. Screen shots of the installation process are also presented.

1. To begin the installation, run SETUP.EXE.

2. Setup will first determine whether the necessary version of the .NET Framework is present, installing it, if necessary. This installation can be time-consuming, ranging from 5 to 20+ minutes, depending on the system. Installation of the .NET Framework requires a reboot to complete.

3. Setup will next determine whether the necessary version of the Microsoft ReportViewer component is present, installing it, if necessary.

4. Finally, AirportGEAR will install the application and content. This step should take less than a minute to complete.

AirportGEAR Setup

For the following components:

Microsoft Visual Studio 2010 Report Viewer

Please read the following license agreement. Press the page down key to see the rest of the agreement.

```
MICROSOFT SOFTWARE LICENSE TERMS
MICROSOFT REPORTVIEWER 2010
These license terms are an agreement
between Microsoft Corporation (or
based on where you live, one of its
affiliates) and you.  Please read
them.  They apply to the software
named above, which includes the
```

View EULA for printing

Do you accept the terms of the pending License Agreement?

If you choose Don't Accept, install will close. To install you must accept this agreement.

[Accept]   [Don't Accept]

AirportGEAR Setup

Installing Microsoft Visual Studio 2010 Report Viewer...

[Cancel]

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Upon completion, AirportGEAR will install a startup icon on the desktop and launch itself. This may take a few moments to complete. A successful installation should result in the image below.
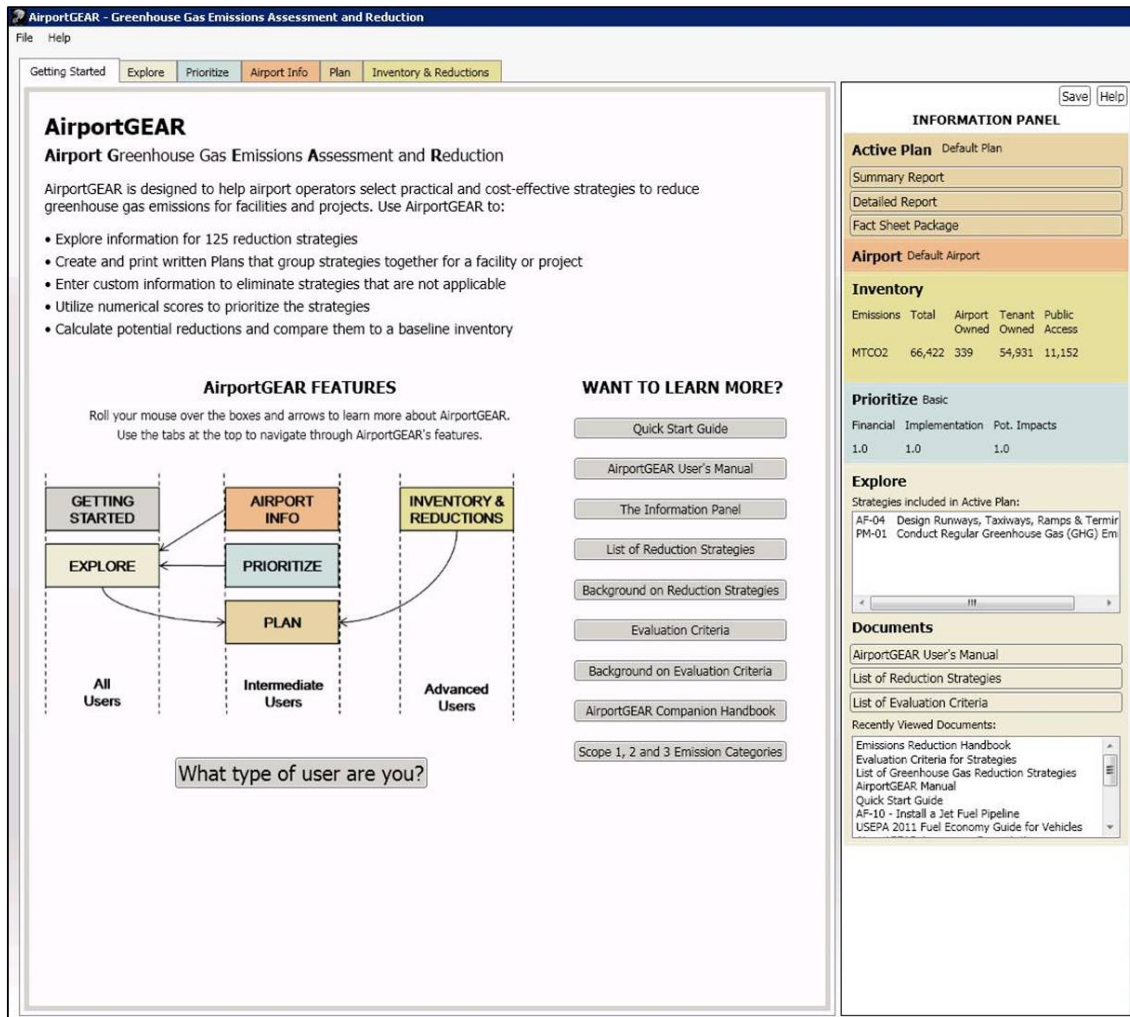
3.3 Troubleshooting

If AirportGEAR does not work correctly after following the preceding steps, the user may consider uninstalling Adobe Reader and AirportGEAR, even if Adobe Reader was installed on the computer prior to the initial AirportGEAR installation. After uninstalling these two programs, re-install them by following the instructions in Sections 3.1 and 3.2.

SECTION 4: Quick Start Guide

This Quick Start Guide provides the critical information for using AirportGEAR. Detailed information for each feature is presented in Section 5 of the User's Manual.

- The foundation of AirportGEAR is the technical information for the greenhouse gas emission reduction strategies that is presented in the Fact Sheets. The features of AirportGEAR allow you to easily access this information in a meaningful way in order to facilitate evaluation and selection of the strategies.

- The **EXPLORE** feature is the heart of AirportGEAR. In **EXPLORE**, you can browse, sort, filter and search the technical information for the reduction strategies to narrow down the list of 125 strategies to a more manageable subset that are customized to your needs.

- The **PLAN** feature is where you organize the strategies that you select for a facility or project. Create a plan in the **PLAN** feature and add strategies to it from the LIST tab in **EXPLORE**. You must create a plan and add strategies to it in order to generate a written report. The strategies in the LIST tab of **EXPLORE** are not automatically added to the active plan; you must click the "ADD" button next to each strategy name to add them to a plan and generate a written report.

- While you can create multiple plans, you can only work on one plan at a time (i.e., the "active" plan). The "active" plan and other relevant information are displayed in the Information Panel that is shown in every feature of AirportGEAR.

- The **AIRPORT INFO** feature is used to screen out strategies that are not applicable to your airport. Depending on the airport's characteristics, certain strategies are eliminated from view in **EXPLORE**.

- The **PRIORITIZE** feature is used to change the numerical scores that are calculated by AirportGEAR for each strategy based on the rating values for the evaluation criteria. In **PRIORITIZE**, you can designate "weights" or importance factors to each evaluation criteria and AirportGEAR recalculates the numerical score. The scores are presented in the LIST tab of **EXPLORE**. You can click on the header entitled "Total Score" in the LIST tab to sort the strategies by score; the strategies with the highest scores are the most desirable.

- You do not have to use every feature of AirportGEAR to find value in the tool. Different features will be used in different ways depending on your goals. Refer to the section entitled "What Type of User are You?" in the User's Manual and the Help function for guidance on using AirportGEAR's features to achieve your goals.

SECTION 5: AirportGEAR Features

This section includes detailed information on AirportGEAR's feature. For each feature, the following information is provided:

Screenshot(s) of the Feature

Purpose of the Feature

How the Feature Works

Recommended Uses of the Feature

5.1 GETTING STARTED

Screenshot of GETTING STARTED

Purpose of GETTING STARTED

The purpose of **GETTING STARTED** is threefold:

1. Provide information on how to use AirportGEAR

2. Provide background on the reduction strategies

3. Provide information on greenhouse gas emission reduction in general

How GETTING STARTED Works

GETTING STARTED provides links to important information regarding how to use AirportGEAR, how the technical information in AirportGEAR was developed, and greenhouse gas emission reduction strategies in general. You can roll your mouse over the features and the arrows between the features in the diagram in **GETTING STARTED** to learn more about their purpose and how they relate to each other. You can also click on the links to other important information to gain background knowledge on using AirportGEAR to evaluate and select greenhouse gas emission reduction strategies for your airport.

The information provided in **GETTING STARTED**, and in this section of the User's Manual, includes:

- AirportGEAR's Features

- Quick Start Guide

- What Type of User are You?

- The Information Panel

- 125 Greenhouse Gas Reduction Strategies

- Background on the 125 Greenhouse Gas Emission Reduction Strategies

- Evaluation Criteria

- Background on the Evaluation Criteria

- AirportGEAR Companion Handbook

- Scope 1, 2 and 3 Emission Categories

The links in **GETTING STARTED** for the Quick Start Guide, the 125 Greenhouse Gas Reduction Strategies, Evaluation Criteria, and AirportGEAR Companion Handbook redirect you to the LIBRARY tab in **EXPLORE** because these documents are stored in the LIBRARY. To get back to the **GETTING STARTED** page from the LIBRARY, click on the **GETTING STARTED** tab at the top of AirportGEAR. The other links open up a new Help window.

AirportGEAR's FEATURES

AirportGEAR uses six features to assist airport operators in analyzing and selecting greenhouse gas emission reduction strategies for facilities or projects, as presented in **Figure 1** and the detailed descriptions below. The colored tabs at the top of AirportGEAR are used to navigate through AirportGEAR's features. This User's Manual, the Help function, and the Information Panel are also provided to assist you in navigating and using AirportGEAR's features.
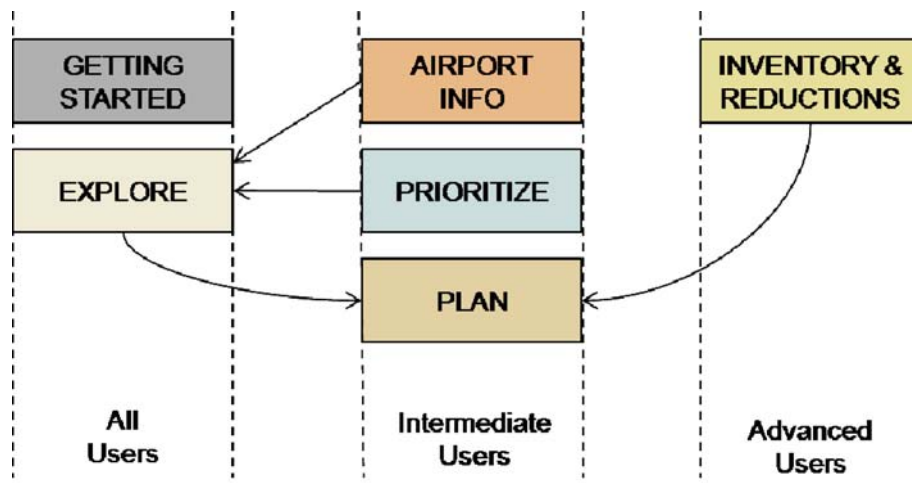
Figure 1. AirportGEAR's features

AirportGEAR's features include:

1. **GETTING STARTED**: Read through background information about the reduction strategies and how to use AirportGEAR to reduce greenhouse gas emissions.

2. **EXPLORE**: Browse, sort, filter, and search the 125 reduction strategies or access the LIBRARY of documents that contain background information. From **EXPLORE**, the user can also select strategies for a facility or project and add them to a plan in the **PLAN** feature.

3. **PRIORITIZE**: Rank the evaluation criteria (e.g., cost) to prioritize the reduction strategies according to your needs and preferences. Your custom prioritization of the evaluation criteria changes the numerical score calculated by AirportGEAR for each strategy, thus allowing you to see which strategies are most applicable to your facility or project (i.e., the strategies with the highest numerical scores are the most desirable). The numerical scores are presented in the LIST tab in **EXPLORE**.

4. **AIRPORT INFO**: Enter airport-specific information to determine which strategies are most applicable to your facility or project. The custom information entered by the user is used to eliminate strategies that are not applicable to your airport. The strategies are eliminated from view in **EXPLORE**.

5. **PLAN**: Group strategies for a specific facility or project and store your choices in written reports.

6. **INVENTORY & REDUCTIONS**: Estimate potential emission reductions for each of the selected strategies and see how those reductions impact your greenhouse gas inventory. The comparison of your greenhouse gas inventory before and after implementation of the selected strategies is presented in the written reports that are organized in **PLAN**.

WHAT TYPE OF USER ARE YOU?

The features of AirportGEAR are designed to assist airport operators in reducing greenhouse gas emissions whether they are in the initial stages of learning about greenhouse gas mitigation or already have greenhouse gas emission reduction activities underway. Airport operators at different levels of progress in their greenhouse gas mitigation will find different AirportGEAR features more useful depending on their current and planned

activities and objectives. Examples of using AirportGEAR based on different types of users are described below.

1. I'm Curious About Greenhouse Gas Mitigation

2. I'm Starting to Plan for Greenhouse Gas Emission Reductions

3. I'm Interested in Greenhouse Gas Emission Reduction Strategies for a Particular Project

4. I'm Interested in Greenhouse Gas Emission Reduction Strategies for a Particular Operation

5. I'm Interested in Greenhouse Gas Emission Reduction Strategies that Give the "Best Bang for the Buck"

6. I'm Ready to Fund Greenhouse Gas Emission Reduction Activities

7. I Have to Meet a Greenhouse Gas Emission Reduction Target

8. I'm Developing or Updating a Climate Action Plan

1. *I'm Curious About Greenhouse Gas Mitigation*

An airport operator that is curious about greenhouse gas emission reduction strategies but does not plan to actively pursue mitigation initiatives will likely find the most use in the **EXPLORE** feature, where the complete list of 125 greenhouse gas reduction strategies can be browsed, sorted and filtered. Key references are also included in the LIBRARY tab of the **EXPLORE** feature that offer background information on greenhouse gas reduction in general. The **GETTING STARTED** feature also includes information on how to use AirportGEAR that may be useful.

2. *I'm Starting to Plan for Greenhouse Gas Emission Reductions*

An airport operator that is in the beginning stages of planning for greenhouse gas emission reductions for a facility or a project and is tasked with developing a list of potential reduction strategies will likely find the most use in the **EXPLORE** feature. Using **EXPLORE**, the airport operator can determine which of the 125 reduction strategies warrant further discussion and exploration. Users can create a plan in the **PLAN** feature, add strategies they are interested in to the plan from the LIST tab in **EXPLORE**, and print the "Summary Report" and the "Fact Sheet

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Package" from **PLAN** to facilitate discussions. The Fact Sheets, also located in the LIBRARY tab of **EXPLORE**, can support subsequent discussions.

3. *I'm Interested in Greenhouse Gas Emission Reduction Strategies for a Particular Project*

An airport operator that would like to integrate greenhouse gas emission reduction strategies into a specific project will likely find the most use in the **EXPLORE** feature. Using the SEARCH tab in **EXPLORE**, the airport operator can use the check boxes at the bottom to select a Project Type(s) (planning, design and/or construction) and a Functional Area(s) of the airport (e.g., buildings, pavement, rental cars, baggage, signage, parking, etc.). Following, the user can click on the "Show Results" button at the top to view the list of strategies that are applicable to that Project Type and Functional Area(s). Following, users can create a plan in the **PLAN** feature, add strategies they are interested in to the active plan from the LIST tab in **EXPLORE** by clicking the "ADD" button, and print the "Summary Report" and the "Fact Sheet Package" from **PLAN** to facilitate discussions and decision-making activities.

4. *I'm Interested in Greenhouse Gas Emission Reduction Strategies for a Particular Operation*

An airport operator that would like to integrate greenhouse gas emission reduction strategies into a specific operation will likely find the most use in the **EXPLORE** feature. Using the SEARCH tab in **EXPLORE**, the airport operator can use the check boxes at the bottom to select an Operation(s) (airside operations, landside operations or administrative) and a Functional Area(s) of the airport (e.g., buildings, pavement, rental cars, baggage, signage, parking, etc.). Following, the user can click on the "Show Results" button at the top to view the list of strategies that are applicable to that Operation and Functional Area(s). Following, users can create a plan in the **PLAN** feature, add strategies they are interested in to the active plan from the LIST tab in **EXPLORE** by clicking the "ADD" button, and print the "Summary Report" and the "Fact Sheet Package" from **PLAN** to facilitate discussions and decision-making activities.

5. *I'm Interested in Greenhouse Gas Reduction Strategies that Give the "Best Bang for the Buck"*

An airport operator that is tasked with reducing greenhouse gas emissions and has limited resources will likely find the most use in the **AIRPORT INFO**, **PRIORITIZE**, **EXPLORE** and **PLAN** features:

- In the **AIRPORT INFO** feature, the user can enter airport-specific information to eliminate strategies that are not applicable to that facility. The strategies are eliminated from view in **EXPLORE**.

- The user can go to the SEARCH tab in **EXPLORE** and set the sliders to show the least expensive strategies (e.g., one or two $ icons) and the greatest greenhouse gas benefits (e.g., two or three smoke stacks for Scopes 1 & 2 and Scope 3). After, click on the button entitled "Show Resulting Strategies" to present the list of strategies that match those criteria. This method can be used with or without user-defined inputs in **PRIORITIZE** and **AIRPORT INFO**.

- In the **PRIORITIZE** feature, the user can "weight" the evaluation criteria related to cost (i.e., estimated capital cost, estimated operation and maintenance costs, and estimated payback period) and greenhouse gas reduction potential higher than the other evaluation criteria. The weighting will be reflected in the numerical score that is calculated by AirportGEAR for each strategy. The numerical score is presented in the LIST tab in **EXPLORE**.

- After prioritization of the evaluation criteria, the user can go to the LIST tab in **EXPLORE** and sort the strategies to show those with the lowest costs or the highest numerical score by clicking on the header names (e.g., click on "Total Score" to sort the strategies by ascending or descending score values). Strategies with the highest scores are the most desirable.

- In **PLAN**, users can create a plan to organize the strategies they are interested in. From the LIST tab in **EXPLORE**, the user can select the strategies that fit the airport's operating conditions and resources and add them to the active plan by clicking the "ADD" button. Following, users can print the "Summary Report" and the "Fact Sheet Package" from **PLAN** to facilitate discussions and decision-making activities.

6. *I'm Ready to Fund Greenhouse Gas Emission Reduction Activities*

An airport operator that is ready to select greenhouse gas emission reduction strategies for consideration for funding and implementation will likely find the most use in **AIRPORT INFO**, **PRIORITIZE**, **EXPLORE** and **PLAN**:

- In the **AIRPORT INFO** feature, the user can enter airport-specific information to eliminate strategies that are not applicable to that facility. The strategies are eliminated from view in **EXPLORE**.

- In the **PRIORITIZE** feature, the user can "weight" the evaluation criteria to reflect custom needs and preferences. The weighting will be reflected in the numerical score that is calculated by AirportGEAR for each strategy and displayed in the LIST tab of **EXPLORE**. The numerical scores can be used to prioritize the strategies (e.g., the highest scores are the most desirable). Click on "Total Score" header in the LIST tab in **EXPLORE** to sort the strategies by ascending or descending score values.

- **EXPLORE** allows the user to evaluate and select the strategies that are most appropriate for a facility or project and organize them in a plan. For example, an airport operator may develop a plan focused on energy management and a plan focused on airfield design to support different decision-making activities within the organization.

- In **PLAN**, users can create a plan(s) to organize the strategies they are interested in. From the LIST tab in **EXPLORE**, the user can select the strategies that fit the airport's operating conditions and resources and add them to the active plan by clicking the "ADD" button. Following, users can print the "Summary Report" and the "Fact Sheet Package" from **PLAN** to facilitate discussions and decision-making activities.

7. *I Have to Meet a Greenhouse Gas Emission Reduction Target*

An airport operator that has made a commitment to a specific greenhouse gas emission reduction target (e.g., 80% reduction compared to 2000 levels) will likely find the most use in the **AIRPORT INFO**, **PRIORITIZE**, **EXPLORE**, **INVENTORY & REDUCTIONS**, and **PLAN** features.

- In the **AIRPORT INFO** feature, the user can enter airport-specific information to eliminate strategies that are not applicable to that facility. The strategies are eliminated from view in **EXPLORE**.

- In the **PRIORITIZE** feature, the user can "weight" the evaluation criteria to reflect custom needs and preferences. The weighting will be reflected in the numerical score that is calculated by AirportGEAR for each strategy and displayed in the LIST tab of **EXPLORE**. The numerical scores can be used to prioritize the strategies (e.g., the highest scores are the most desirable). Click on "Total Score" header in the LIST tab in **EXPLORE** to sort the strategies by ascending or descending score values.

- Using **EXPLORE**, the user can evaluate and select those strategies that are most appropriate for a facility or project and add them to a plan. Strategies can be added to the active plan by clicking the "ADD" button next to the strategy name in the LIST tab in **EXPLORE**.

- In the **INVENTORY & REDUCTIONS** feature, the user can enter in the greenhouse gas inventory for the baseline year. The user can also estimate the amount of greenhouse gas emission reduction that may occur by entering specific data regarding implementation of each of the selected strategies. For example, for energy management strategies that reduce electricity use, the user can enter the estimated amount of electricity that will be saved from implementing the strategy and then calculate the equivalent amount of greenhouse gas emissions that will be reduced.

- In **PLAN**, users can create a plan(s) to organize the strategies they are interested in. From the LIST tab in **EXPLORE**, the user can select the strategies and add them to the active plan by clicking the "ADD" button. Following, users can print the "Detailed Report" and the "Fact Sheet Package" from **PLAN** to facilitate discussions and decision-making activities. The report will summarize the key information about each of the selected strategies, including the results of the calculations, and compare the baseline greenhouse gas inventory to the inventory that would result after implementation of the selected strategies. This comparison will allow the airport operator to estimate the amount of reduction that can be achieved and gauge whether it will result in meeting the targeted goal.

8. *I'm Developing or Updating a Climate Action Plan*

An airport operator that is developing or updating a Climate Action Plan will likely find the most use in the **AIRPORT INFO**, **PRIORITIZE**, **EXPLORE**, **INVENTORY & REDUCTIONS**, and **PLAN** features.

In the **AIRPORT INFO** feature, the user can enter airport-specific information to eliminate strategies that are not applicable to that facility. The strategies are eliminated from view in **EXPLORE**.

In the **PRIORITIZE** feature, the user can "weight" the evaluation criteria to reflect custom needs and preferences. The weighting will be reflected in the numerical score that is calculated by AirportGEAR for each strategy and displayed in the LIST tab of **EXPLORE**. The numerical scores can be used to prioritize the strategies (e.g., the highest scores are the most desirable). Click on "Total Score" header in the LIST tab in **EXPLORE** to sort the strategies by ascending or descending score values.

Using **EXPLORE**, the user can evaluate and select those strategies that are most appropriate for a facility or project and add them to a plan. Strategies can be added to the active plan by clicking the "ADD" button next to the strategy name in the LIST tab in **EXPLORE**.

In the **INVENTORY & REDUCTIONS** feature, the user can enter in the greenhouse gas inventory for the baseline year. The user can also estimate the amount of greenhouse gas emission reduction that may occur by entering specific data regarding implementation of each of the selected strategies. For example, for energy management strategies that reduce electricity use, the user can enter the estimated amount of electricity that will be saved from implementing the strategy and then calculate the equivalent amount of greenhouse gas emissions that will be reduced.

In **PLAN**, users can create a plan(s) to organize the strategies they are interested in. From the LIST tab in **EXPLORE**, the user can select the strategies and add them to the active plan by clicking the "ADD" button. Following, users can print the "Detailed Report" and the "Fact Sheet Package" from **PLAN** to facilitate discussions and decision-making activities. The report will summarize the key information about each of the selected strategies The plan(s) can be used for discussions and decision-making activities to determine which strategies can be funded and implemented or to report projected greenhouse gas emission reductions in the Climate Action Plan.

QUICK START GUIDE

The Quick Start Guide is intended to provide a one-page summary of the critical information for using AirportGEAR. The Quick Start Guide is included in Section 4 of this User's Manual.

THE INFORMATION PANEL

The Information Panel is always displayed on the right side of the screen and provides important information and links. The Information Panel includes:

The "active" plan. While you can create multiple plans in AirportGEAR, you can only work on one plan at a time. For the "active" plan, you can add strategies in **EXPLORE**, enter inventory data and calculate potential emission reductions in **INVENTORY & REDUCTIONS**, and print reports in **PLAN**.

The description of the active plan.

Links to the reports for the active plan.

The airport that is the focus on the active plan.

Emission totals for the active plan (if entered by the user).

Indication of which prioritization scheme is being used (Basic or Pairwise Comparison) and what weights have been entered for the three categories of evaluation criteria (financial considerations, implementation considerations, and potential impacts).

The strategies that have been added to the active plan.

Links to this User's Manual, the list of reduction strategies and the list of evaluation criteria.

Recently viewed documents.

125 REDUCTION STRATEGIES

The list of the 125 greenhouse gas emission reduction strategies is included in **Addendum 1** at the end of this User's Manual.

BACKGROUND ON THE 125 EMISSION REDUCTION STRATEGIES

AirportGEAR includes 125 greenhouse gas emission reduction strategies in 12 categories, as shown in **Table 1**. Each category has a two-letter abbreviation and a picture to assist with navigation between the categories.

The strategies can be used to reduce emissions for both a specific facility (e.g., minimizing the use of auxiliary power units) and for a specific project (e.g., installing energy efficient equipment as part of a building renovation).

Each reduction strategy was analyzed according to a set of 11 evaluation criteria to consistently provide readers with a summary of critical information that is often used in decision-making activities. For example, the magnitude of capital cost and the greenhouse gas reduction potential were used as criteria for evaluating each reduction strategy.

In addition to the results of the evaluation criteria analysis, other critical information is provided for each strategy in a four-page Fact Sheet, including:

A description of the reduction strategy that outlines specific actions an airport operator can take to initiate implementation

Greenhouse gas emission sources impacted by the reduction strategy

Geographic regions and airport sizes that are favorable for implementation

Space requirements

Airport activities impacted by the reduction strategy (e.g., planning, construction, airside operations)

Implementation areas that may be impacted by the reduction strategy (e.g., roadways, terminals, signage)

Recommended stakeholder engagement

Funding opportunities
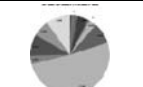
Case studies

On-line resources

Key references

Related reduction strategies

Table 1.
Categories of Greenhouse Gas
Emission Reduction Strategies in AirportGEAR

Category	Abbreviation for Category	Number of Strategies	Picture for Category
Airfield Design and Operations	AF	18	
Business Planning	BP	11	
Construction	CN	5	
Carbon Sequestration	CS	4	
Energy Management	EM	39	
Ground Service Equipment	GS	1	
Ground Transportation	GT	17	
Materials and Embedded Energy	ME	4	
Operations and Maintenance	OM	3	
Performance Measurement	PM	5	
Renewable Energy (on-site)	RE	14	
Refrigerants	RF	4	
Total:		125	

Photo sources: GT – Los Angeles World Airports; PM – Adapted from *ACRP Report 11*; RE – Denver International Airport; BP, CS, CN, EM, ME, and OM – Office.Microsoft.com Media Gallery © Microsoft.

The Fact Sheets communicate the technical information for each strategy in a consistent, user-friendly format. The Fact Sheets are included in the companion Handbook and can also be viewed in AirportGEAR in the LIBRARY tab of the **EXPLORE** feature. An airport operator can use the Fact Sheets to learn more about each strategy and to support decision-making activities.

The list of reduction strategies and supporting technical information were derived from published literature, interviews with airports, vendor information, institutional knowledge of the airport industry, and professional judgment of the research team. Specifically, key sources for the information include the airport trade associations [American Association of Airport Executives (AAAE), Airports Council International (ACI), and Airport Consultants Council (ACC), and the International Civil Aviation Organization (ICAO)], airport users [Air Transport Association (ATA)], federal agencies [(U.S. Environmental Protection Agency (EPA), Department of Transportation (DOT) and Department of Energy (DOE)], and state programs, such as the California Climate Action Registry (CCAR). Pertinent research from the Transportation Research Board (TRB) was also used to develop the greenhouse gas emission reduction strategies.

THE EVALUATION CRITERIA

The list of evaluation criteria and their definitions is included in **Addendum 2** at the end of this User's Manual.

BACKGROUND ON THE EVALUATION CRITERIA

Each reduction strategy was analyzed against a set of 11 evaluation criteria to provide readers with a summary of critical information that is often used in decision-making activities. The evaluation criteria are grouped into three categories, as shown in **Table 2**.

Table 2.
Evaluation Criteria Used to Analyze the
Greenhouse Gas Emission Reduction Strategies

Category	Evaluation Criteria	Description
Financial Considerations	Estimated Capital Cost	Upfront costs to plan, design and/or construct the reduction action
	Estimate Operation and Maintenance Cost	Annual costs for continued implementation
	Estimated Payback Period	The time required for the return on an investment to "repay" the capital and operations and maintenance costs
Implementation Considerations	Implementation Timeframe	The time period required to implement the strategy
	Maturity of Strategy	Past demonstration that the reduction strategy is implementable and effective
	Airport Control	The level of financial and logistical control of the airport operator to implement the reduction strategy
Potential Impacts	Greenhouse Gas Reduction Potential: Scopes 1 & 2	The magnitude of the reduction in Scope 1 & 2 greenhouse gas emissions (Direct and Indirect emissions)
	Greenhouse Gas Reduction Potential: Scope 3	The magnitude of the reduction in Scope 3 greenhouse gas emissions (Other emissions)
	Impacts to Natural Resources	Impacts or secondary benefits to natural resources
	Impacts to the Built Environment	Impacts or secondary benefits for the built environment and local communities
	Impacts to Regulatory Compliance	Impacts or secondary benefits for the airport operator's compliance status with regulations

For each of the evaluation criteria, a "rating value" was assigned to indicate the results of the analysis. The rating values are shown as visual icons to allow the user to quickly interpret the results. For example, the strategies with the least expensive capital costs have a rating value icon of one dollar sign ($) while those with the most expensive capital costs receive a rating value icon of four dollar signs ($$$$).

Additionally, AirportGEAR calculates a numerical score for each strategy based on the rating values, with the highest score indicating the most desirable strategies. These numerical scores, which are normalized to be between zero and one hundred, can be used to help prioritize which strategies may be the most applicable for a specific airport (e.g., the strategies with the highest scores are the most desirable). The numerical scores are displayed in the LIST of **EXPLORE.**

AirportGEAR COMPANION HANDBOOK

The AirportGEAR companion Handbook contains detailed background information on the objectives and methodologies that were used to develop the technical information for the 125 greenhouse gas emission reduction strategies included in AirportGEAR. The Handbook also includes a brief description of greenhouse gas emission accounting principles, potential regulatory requirements, and recommendations for how to use the Fact Sheets. The AirportGEAR Companion Handbook is located in the LIBRARY tab in **EXPLORE**.

SCOPE 1, SCOPE 2 AND SCOPE 3 EMISSION CATEGORIES

When developing a greenhouse gas inventory, emissions are often categorized as *Scope 1, Scope 2, or Scope 3*. Each scope of emissions indicates the relative amount of control that the airport has over the sources of emissions and, potentially, how the emissions may be regulated. The World Resource Institute (WRI) adopted the terms Scope 1/2/3, which have become standards for inventories, and are defined as:

Scope 1 emissions are from sources that are owned *and* controlled by the airport. For example, emissions from combustion in airport-owned boilers, furnaces and vehicles are considered to be Scope 1. Scope 1 sources for an airport operator typically include: airport service/fleet vehicles, certain stationary sources, emissions from airport-owned aircraft, and refrigerant use by the airport operator. Existing and emerging regulations often focus on Scope 1 emissions.

Scope 2 emissions are the purchase of electricity or steam by the airport. In this case, the practice is to associate electrical and steam purchases to the entity that receives the bill which may or may not be the consumer. Therefore, if the airport operator receives the electrical and steam bill and then later invoices their tenants, the airport operator reports all airport electrical consumption as Scope 2. If tenants are directly billed by the utility provider, the electrical consumption of the tenant is reported as Scope 3. Scope 2 emissions are often included in voluntary reporting registries.

Scope 3 emissions are a consequence of the activities of the entity, but occur at sources owned or controlled by another party. At an airport, these emissions would be associated with tenant aircraft operations, tenant ground support equipment, tenant ground vehicle movement, and public vehicular access to and from the airport. Scope 3 emissions can account for up to 90 – 95 percent of greenhouse gas emissions in an airport's inventory. Airports may influence Scope 3 emissions, but cannot directly control them.

Recommended Uses of GETTING STARTED

GETTING STARTED may be used as a "home base" for AirportGEAR, which can be accessed any time you are using the tool and need additional information. Before exploring the other AirportGEAR features, it is recommended that you use **GETTING STARTED** to familiarize yourself with AirportGEAR's features, the list of 125 reduction strategies and the list of evaluation criteria. While the other information provided in **GETTING STARTED** is important for reducing greenhouse gas emissions, you can read this information on an as-needed basis as you use AirportGEAR to evaluate and select emission reduction actions.

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5.2   EXPLORE

🖥 Screenshots of EXPLORE

AirportGEAR User's Manual

Purpose of EXPLORE

EXPLORE is the heart of AirportGEAR. The purpose of **EXPLORE** is to provide you with several methods of browsing, filtering, sorting, and searching the technical information available for each reduction strategy. **EXPLORE** is also intended to provide a working space for you to develop a customized list of strategies that are most applicable to your airport that you can add to a written plan in the **PLAN** feature.

How EXPLORE Works

The **EXPLORE** feature allows you to browse, sort, filter and search the 125 greenhouse gas reduction strategies. For example, you can filter the strategies to show the least expensive and/or those that have the greatest greenhouse gas emission reduction potential. You can also search for key words or filter the strategies to show those that are applicable to a certain

Project Type and/or Functional Area of the airport. You can also browse the LIBRARY of important background documents.

The **EXPLORE** feature has three components (each located on a separate tab in **EXPLORE**):

1. LIST
2. SEARCH
3. LIBRARY

LIST

The LIST tab of **EXPLORE** shows the list of greenhouse gas reduction strategies and their numerical scores. The rating values for the evaluation criteria are also shown in the LIST tab. The LIST tab is designed for easy browsing and sorting of the reduction strategies and their information. The information in the LIST tab can be used in several ways:

Click on the table headers to sort the list of strategies by strategy name, strategy number, numerical score, or evaluation criteria rating values.

View all of the 125 strategies by unchecking the box at the top entitled "Show Only Search Results".

View only the strategies that result from the parameters set in the SEARCH tab by checking the box at the top entitled "Show Only Search Results".

Add strategies to a plan by clicking the "Add" button next to the strategy name. The strategy will be added to the plan that is currently "active" in the **PLAN** feature, which is displayed in the Information Panel.

Edit the rating value for any of the evaluation criteria by clicking the box where the number is located. The user can edit the rating values for the evaluation criteria if the default values provided by AirportGEAR are incorrect for your airport or region or change over time.

View the Fact Sheet for each strategy by clicking on the strategy number.

Change the width of the columns by moving the column lines to the left or the right (similar to Microsoft Excel).

Highlight information in the LIST table, press "Ctrl" and "C" at the same time to copy the data, and paste it in a Microsoft Excel file outside of AirportGEAR.

SEARCH

The SEARCH tab in **EXPLORE** allows you to filter the strategies by the rating values for the evaluation criteria (e.g., the least expensive strategies). You can also filter the strategies by their applicability to a Project Type or Functional Area of the airport, the space that is required to implement the strategy, and the source of greenhouse gas emissions. You can also search for key words in the Fact Sheets.

Move the "sliders" at the top to set the desired ranges of the rating values for the evaluation criteria. For example, move the sliders all the way to the left for 'Estimated Capital Cost' to view the least expensive strategies (i.e., those with a rating value of one $). As you change the sliders, the number of applicable strategies will automatically change at the top of the page.

Check the boxes at the bottom to search for strategies that are applicable to a Project Type or Functional Area of the airport, have specific space requirements or are emitted from a certain source.

Enter a key word in the text box at the top of the page. AirportGEAR will search the Fact Sheets for this word and return the strategies that contain it.

Click the "Show Resulting Strategies" button at the top to see the resulting strategies that match the parameters set with the sliders, check boxes and key words. Clicking the "Show Results" button will redirect you to the LIST tab where the resulting strategies are displayed.

Click the "Reset Criteria" button at the top to reset the sliders, check boxes and key words back to the default values.

The "sliders" on the top half of the SEARCH tab use "AND" logic. For example, setting the "sliders" to one dollar sign ($) for 'Estimated Capital Cost' and four airplanes (✈✈✈✈) for 'Airport Control' will return strategies that have both of these values for the evaluation criteria. In other words, it shows strategies that have $ *and* ✈✈✈✈, as opposed to $ *or* ✈✈✈✈. With this "AND" logic, it is recommended that only 1 or 2 sliders be used at a time.

The check boxes on the bottom half of the SEARCH tab use a combination of "AND" and "OR" logic. For example, if 'Construction' is checked under Project Type and 'Parking' and 'Baggage' are checked under Functional Area, AirportGEAR will return strategies that are applicable during construction for either a parking facility or a baggage facility.

LIBRARY

The LIBRARY tab in **EXPLORE** contains reference documents that may be helpful to you as you use AirportGEAR and evaluate greenhouse gas emission reduction strategies. Descriptions of the documents are presented in **Table 3**.

NOTE: The documents included in the LIBRARY tab may be superseded by more recent versions over time. Please refer to the original authors of the documents for the most recent versions.

Table 3.
Documents in the LIBRARY Tab of EXPLORE

	Document	Description
	Handbook for Assessing Practical Greenhouse Gas Emission Reduction Strategies for Airports	The companion Handbook for AirportGEAR. It contains background information of greenhouse gas reduction and describes how the technical information presented in AirportGEAR was determined.
	AirportGEAR User's Manual	Includes information on how to use AirportGEAR
	AirportGEAR Quick Start Guide	A one-page guide to the critical information for using AirportGEAR
	List of the Emission Reduction Strategies	A table that includes the list of the 125 greenhouse gas emission reduction strategies included in AirportGEAR
	Evaluation Criteria Definitions	A table that provides the descriptions and rating value definitions for the evaluation criteria used in AirportGEAR
	AirportGEAR References	A list of the references used in the research that was used to develop AirportGEAR

Table 3.
Documents in the LIBRARY Tab of EXPLORE

	Document	Description
	AirportGEAR Awareness Presentation	A presentation summarizing the project information that can be used for garnering support for greenhouse gas emission reduction activities.
	Fact Sheets	The four-page Fact Sheets for each of the greenhouse gas emission reduction strategies included in AirportGEAR.
	ACRP Report 11: Guidebook on Preparing Airport Greenhouse Gas Emission Inventories	This report is a product of a previous ACRP Project (02-06) and offers guidance to airports on greenhouse gas accounting.
	The Climate Registry, General Reporting Protocol	This document contains information on one reporting protocol in North America and includes emission factors used to calculate greenhouse gas emissions from stationary, mobile, indirect, and fugitive sources.
	The Intergovernmental Panel on Climate Change (IPCC), Guidelines for National Greenhouse Gas Inventories (2006), Volume 2, Energy	This document contains information on a global reporting protocol and includes emission factors used to calculate greenhouse gas emissions related to energy use.
	The United States Environmental Protection Agency's (U.S. EPA's) 2011 Fuel Economy Guide	This document contains fuel efficiency data that is commonly used to calculate greenhouse gas emissions from vehicles.

Table 3.
Documents in the LIBRARY Tab of EXPLORE

Document	Description
U.S. EPA's eGrid 2010 Version 1 Year 2007 Summary Tables	This document contains emission factors for electricity grids in the United States for 2007 (the most recent emission factors at the time of publication).

Recommended Uses of EXPLORE

Each tab in **EXPLORE** can be used differently to evaluate and select the greenhouse gas reduction strategies that are most applicable to a specific facility or project. Recommendations for each tab include:

In the LIST tab, click on a header of the table to sort the strategies in ascending or descending order for that column. For example, click on the "Total Score" header to sort the strategies from highest numerical score to lowest to understand which strategies may be most applicable for a facility or project (e.g., the strategies with the highest score are the most desirable).

In the SEARCH tab, set the criteria according to your needs and click the "Show Results" button. For example, set the "sliders" to show the greatest 'Estimated Payback Period' or check the boxes for a specific Project Type and Functional Area. It is recommended that only one or two of the sliders be used at once. The strategies that match those criteria are shown in the LIST tab. Select strategies that you wish to consider further for implementation by clicking the "ADD" button in the LIST tab, which will group the selected strategies in the active plan.

Refer to the LIBRARY tab to view the Fact Sheets and to look up emission factor values when estimating potential emission reductions in **INVENTORY & REDUCTIONS**.

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5.3 PRIORITIZE

Screenshots of PRIORITIZE

Purpose of PRIORITIZE

AirportGEAR calculates a numerical score for each strategy based on the rating values for the evaluation criteria for that strategy. The purpose of **PRIORITIZE** is to allow you to apply "weights" or importance factors to the evaluation criteria in order to change the numerical score to reflect your preferences. The numerical scores are displayed in the LIST tab of **EXPLORE**. The numerical scores can be used to select the best strategies for your airport (e.g., the strategies with the highest score are the most desirable).

How PRIORITIZE Works

The **PRIORITIZE** feature allows you to "weight" the evaluation criteria based on their relativve importance to your airport. The "weights" chaange the numerical score for each strategy that is calculated by AirportGEAR. The numerical scores can be viewed in the LIST tab of the **EXPLORE** feature.

The default numerical score originally calculated by AirportGEAR is based on equal weighting to each criterion (i.e., a weighting of 1 for each criterion). After you assign weights in **PRIORITIZE**, return to the LIST tab of **EXPLORE** and sort the strategies by their new numerical score by clicking on the "Total Score" header. The effects of "weights" on the numerical score are presented in **Table 4**.

You can prioritize the evaluation criteria in two ways (see detailed descriptions below):

1.   Basic or manual assignment of weights

2.   Using the pairwise process to determine weights.

BASIC PRIORITIZATION

You may manually assign a weight to each of the 11 evaluation criteria to weight them from unimportant to critical. Assign a weight between 1 (lowest priority) and 10 (highest priority) for each criterion. Weights can be repeated (e.g., a weight of 10 can be given to more than one criterion).

In addition, if the '1 through 10' scale is too detailed for your needs, the criteria can be ranked using a '1 through 5' scale or a '1 through 3' scale (as determined by the user) with the same results of prioritizing the criteria. Use a modified scale by only selecting values between 1 and 5 or 1 and 3 for each criterion (i.e., a separate scale will not be presented by AirportGEAR. It is up to the user to select the range and values for the weights).

PAIRWISE PRIORITIZATION

You may step through a more time-intensive process that compares each individual criterion to each other to determine which one is more important. While this process will take more time than the *BASIC* prioritization, it will provide you with more detailed results than the simple 1-10 weighting provided in the *BASIC* function. The *PAIRWISE* process is often used in facilitated sessions with large groups of stakeholders, but can also be used by an individual.

Table 4
Example Prioritization: Assigning custom weights to the evaluation criteria changes the numerical score

EVALUATION CRITERION	Weight (1-10, user defined)	AO-2 Minimize the Use of Auxiliary Power Units (APUs)		AO-3 Design Airside Layout to Reduce Aircraft Delay & Surface Vehicle Congestion	
		Rating (Strategy Specific)	Score (Rating x Weight)	Rating (Strategy Specific)	Score (Rating x Weight)
Estimated Capital Cost	10	3	30	1	10
Estimated O&M Cost	9	4	36	2	18
Estimated Payback Period	2	1	2	1	2
Airport Control	2	2	4	4	8
Implementation Timeframe	1	1	1	2	2
Maturity of Strategy	1	4	4	4	4
Greenhouse Gas Reduction: Scopes 1 & 2	9	0	0	0	0
Greenhouse Gas Reduction: Scope 3	7	2	14	3	21
Impacts to Natural Resources	2	2	4	2	4
Impacts to the Built Environment	2	2	4	2	4
Impacts to Regulatory Compliance	2	0	0	2	4
Unweighted Score*		21		23	
Weighted Score*			99		77

* The scores shown in this example have not been normalized. The numerical scores shown in AirportGEAR are normalized between 0 and 100.

Recommended Uses of PRIORITIZE

Start with the *BASIC* prioritization scheme. Manually set values for the "weights" for each criterion. Return to the LIST tab in **EXPLORE** and sort the strategies by score in descending order by clicking on the header for "Total Score."

5.4 AIRPORT INFO

Screenshot of AIRPORT INFO

Purpose of AIRPORT INFO

The purpose of **AIRPORT INFO** is to use airport-specific information to eliminate strategies that are not applicable to that airport. The strategies are eliminated from view in **EXPLORE**.

How AIRPORT INFO Works

In the **AIRPORT INFO** feature, you can enter information on airport size, geography and other characteristics, such as whether the airport is served by public transportation or operates a central utility plant. **Table 5** below shows how the information is used to eliminate strategies for a specific airport. The strategies are eliminated from view in **EXPLORE**.

Table 5.
Strategies that are Eliminated Based on Airport-Specific Information

Characteristic	Strategies that are Eliminated
Airport Size	Strategies that are not applicable to the airport size are eliminated from view in **EXPLORE.**
Airport Geography	Strategies that are not applicable to the airport geography are eliminated from view in **EXPLORE.**
Served by public transportation	If this box is NOT checked, then strategies GT-03 "Promote Public Transit to the Airport" and GT-04 "Provide Transit Fare Discounts and/or Alternative Mode Subsidies" are eliminated from view in **EXPLORE.**
Located on a water body with a tide	If this box is NOT checked, then the strategy RE-11 "Install a Tidal Energy System" is eliminated from view in **EXPLORE.**
Chooses electricity provider/retailer on an open market	If this box is NOT checked, then the strategy EM-04 "Enter into a Green Power Purchasing Agreement" is eliminated from view in **EXPLORE.**

Table 5.
Strategies that are Eliminated Based on Airport-Specific Information

Characteristic	Strategies that are Eliminated
In the process of (or has completed) a Climate Action Plan/Greenhouse Gas Management Plan	If this box is checked, then the strategy BP-03 "Develop a Climate Action Plan (CAP)" is eliminated from view in **EXPLORE.**
Located near a landfill	If this box is NOT checked, then the strategy RE-14 "Utilize Local Landfill Gas" is eliminated from view in **EXPLORE.**
Located on a large water body (with or without a tide)	If this box is NOT checked, then the strategy RE-08 "Use Seawater and Natural Water Bodies for Cooling" is eliminated from view in **EXPLORE.**
Conducts regular greenhouse gas inventories	If this box is checked, then the strategy PM-01 "Conduct Regular Greenhouse Gas Emission Inventories" is eliminated from view in **EXPLORE.**
Operates a central utility plant on site	If this box is NOT checked, then the strategy EM-23 "Evaluate and Upgrade the Central Plant and Distribution System Equipment" is eliminated from view in **EXPLORE.**

You do not need to enter airport-specific information to use AirportGEAR. While user-defined information can enhance your evaluation and selection of reduction strategies, it is not required to use the other AirportGEAR features.

You can also enter airport-specific information and then choose to not use it to eliminate strategies by unchecking the box labeled "Checking this box will use the airport-specific information to eliminate strategies that are not applicable to the airport. The strategies are eliminated from view in **EXPLORE**" at the top of the **AIRPORT INFO** page. Toggling this option on and off allows the user to switch between seeing all of the 125 reduction strategies and those that are only applicable at a specific airport.

Information for more than one airport can be entered and stored in the **AIRPORT INFO** feature of AirportGEAR.

👉 Recommended Uses of AIRPORT INFO

Create a profile for each airport in your organization. For each profile, designate an airport name and select a state and airport size. Check the boxes for the characteristics that apply to each airport. Finally, click on the box at the top that states "Checking this box will use the airport-specific information to eliminate strategies that are not applicable to the airport. The strategies are eliminated from view in **EXPLORE**." Strategies that are not applicable to the airport will be eliminated from view during your evaluation in **EXPLORE**.

5.5 PLAN

🖥 Screenshot of PLAN

Purpose of PLAN

The purpose of **PLAN** is to allow you to group selected strategies together for a facility or project and print written reports that summarize technical information about those strategies. The written reports can be printed and used for discussion purposes and decision-making activities. Examples of a "Summary Report" and a "Detailed Report" that result from **PLAN** are included in **Addendum 3** of this document.

How PLAN Works

The **PLAN** feature allows you to create plans to group strategies together for a facility or a project. Strategies are added to a plan in the LIST tab of **EXPLORE** by clicking the "ADD" button next to the strategy name. You must create a plan and add strategies to it in order to print a written report.

The **PLAN** feature is also used to designate which plan is "active" in AirportGEAR. While you can create multiple plans, you can only work on one plan at a time (i.e., the "active" plan). You can add strategies from the LIST tab in **EXPLORE** and quantify potential emissions reduction in the **INVENTORY & REDUCTIONS** feature. The "active" plan and other relevant information are displayed in the Information Panel that is shown in every feature of AirportGEAR.

In the **PLAN** feature, you can:

Create multiple plans with varying names, descriptions and notes.

View and Print a "Summary Report" or a "Detailed Report" that presents the selected strategies for each plan and their relevant technical information. You can also print a package of the Fact Sheets for the selected strategies.

Export report data to be used in other airport reports, analysis or presentations.

CREATE PLANS

Create multiple plans by clicking the "Add" button in **PLAN**. For each plan that is added, you can designate a plan name and a plan description. If you have multiple airports, you can also indicate which airport the plan is for. The list of airports is derived from the data entered in the **AIRPORT INFO**

feature. In addition, you can enter "Notes" for each plan in the **PLAN** feature.

Once a plan is added, it is displayed in the list located in the box immediately to the right of the "Add" button. From this list, you can delete plans or copy plans. Copying a plan will allow you to transfer the selected strategies and their relevant technical data from one plan to another, which can then be modified, and will prevent you from having to repetitively enter the same data. Highlight a plan in the box to designate it as the "active" plan.

All plans are automatically saved and can be viewed at any time by highlighting the name in the box that contains the list of plans.

VIEW AND PRINT REPORTS

Two types of reports can be viewed or printed from the **PLAN** feature: a "Summary Report" and a "Detailed Report." The package of Fact Sheets for the selected strategies in the active plan can also be printed. The reports are accessed by highlighting the desired plan and clicking on the buttons entitled "Summary Report," "Detailed Report" and "Fact Sheet Package" (located to the left of the list of plans). The content of these reports (described below) can be directly printed to a printer or exported to Microsoft Excel, Microsoft Word or Adobe PDF using the toolbar at the top of the report window.

Examples of a "Summary Report" and a "Detailed Report" can be viewed or printed by clicking on the "Example Summary Report" and "Example Detailed Report" buttons in the PLAN feature.

The "Summary Report" includes the following information:

The names and numbers of the strategies that were selected to be part of the plan.

The category of each strategy (e.g., Energy Management).

The numerical score for each strategy that is calculated by AirportGEAR based on the evaluation criteria rating values and the custom prioritization that is designated by the user in the **PRIORITIZE** feature (if applicable).

Indication of whether the strategy can apply to Scope 1, Scope 2 or Scope 3 emission sources.

Notes for the strategy that are entered by the user in the **PLAN** feature.

The "Detailed Report" includes:

The names and numbers of the strategies that were selected to be part of a plan.

The category of each strategy (e.g., Energy Management).

The numerical score for each strategy that is calculated by AirportGEAR based on the evaluation criteria rating values and the custom prioritization that is designated by the user in the **PRIORITIZE** feature (if applicable).

The potential emissions reductions in metric tonnes of carbon dioxide equivalent (MTCO2e) that were computed in the **INVENTORY & REDUCTIONS** feature.

The unit cost of carbon in dollars per MTCO2e that was computed in the **INVENTORY & REDUCTIONS** feature (if applicable).

The total cost of the strategy, as entered by the user in the **INVENTORY & REDUCTIONS** feature (if applicable).

Indication of whether the strategy can apply to Scope 1, Scope 2 or Scope 3 emission sources.

Notes for the strategy that are entered by the user in the **PLAN** feature.

Bar graphs comparing the estimated reduction in emissions compared to the baseline inventory, which are based on the user-defined inventory data and the reductions calculated in the **INVENTORY & REDUCTIONS** feature (if applicable).

Airport-specific information entered by the user in the **AIRPORT INFO**, **PRIORITIZE** and **INVENTORY & REDUCTIONS** features.

You can also print a "Fact Sheet Package" that compiles all of the Fact Sheets for the selected strategies.

EXPORT REPORT DATA

The data included in the written reports can be exported to Microsoft Excel, Microsoft Word or Adobe for further use in airport reports, analysis or presentations. To export the data, click on the Save or disc icon at the top of the report reviewer, as shown in the following screenshot.
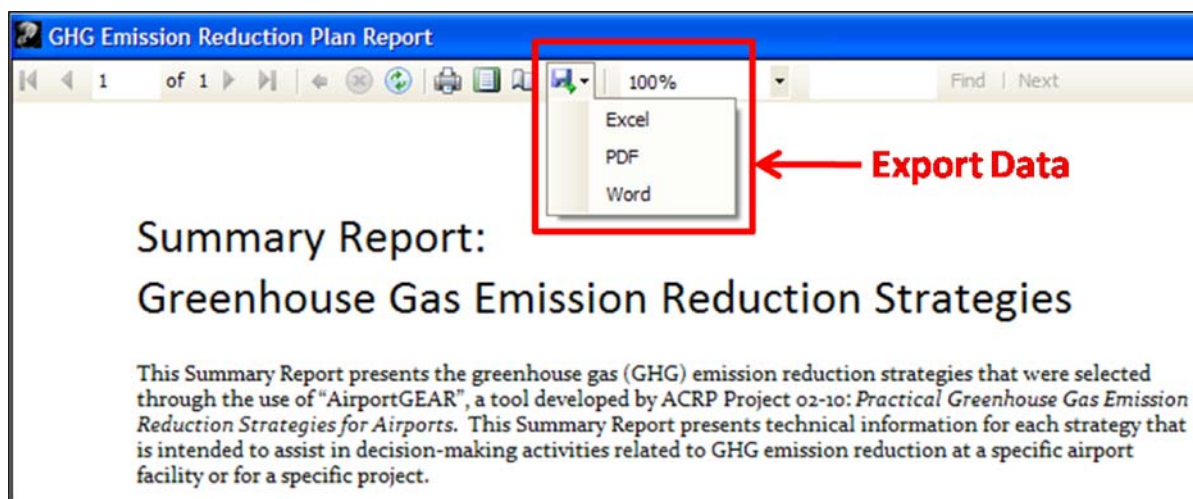
Recommended Uses of PLAN

Example plans that airports may consider developing include:

A comprehensive plan for one airport

A plan for a specific project

A plan for a specific operation

A plan for a particular focus area, such as energy management or ground transportation

A plan for a functional area of the airport, such as cargo facilities or terminals

Graphs from the "Detailed Report" can be exported to Microsoft Excel and then copied into Microsoft PowerPoint presentations.

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5.6 INVENTORY & REDUCTIONS

Screenshots of INVENTORY & REDUCTIONS

✅ Purpose of INVENTORY & REDUCTIONS

The purpose of **INVENTORY & REDUCTIONS** is to allow you to estimate potential greenhouse gas emission reductions that can be realized by implementing each strategy and compare those reductions to a baseline inventory. This comparison will assist you in determining which strategies will have the greatest impact on your overall greenhouse gas footprint. Comparing greenhouse gas inventory data to emission reduction plans can

help you determine if the reduction strategies that you selected address your largest sources of emissions and/or if you are meeting your goals and commitments related to greenhouse gas emission reduction.

How INVENTORY & REDUCTIONS Works

The **INVENTORY & REDUCTIONS** feature has two components (each located on a separate tab in **INVENTORY & REDUCTIONS**): INVENTORY and REDUCTIONS. Detailed information on each of these components is included below. The comparison of the inventory data and the estimated reductions are shown on the written "Detailed Plan" that can be viewed in the **PLAN** feature.

Note that you can use these components independently of each other; you do not need to enter data in both tabs for this feature to work. You can enter inventory data without calculating reductions and vice-versa.

INVENTORY

Enter your greenhouse gas inventory data in this tab. The default greenhouse gas sources listed in this component are taken from *ACRP Report 11: Guidebook on Preparing Airport Greenhouse Gas Emissions Inventories*. If your inventory does not include these sources, use the "Other" boxes to name your additional sources. Rolling the cursor over each default source will give examples of what equipment or operation is typically included in that type of source in a greenhouse gas inventory.

If you do not have an inventory for your airport, you can import an example inventory from a similar airport by selecting a similar airport from the list in the bottom right corner and then clicking the "Import" button.

REDUCTIONS

The REDUCTIONS component can be used to estimate potential greenhouse gas emission reductions from implementing your selected strategies by following four steps:

STEP 1: Select a Strategy

To enter data for a specific strategy, click on a strategy from the list. The list shows the strategies that you selected to be part of the plan that is currently "active" in the PLAN feature.

STEP 2: Enter Estimated Cost Information

You can enter estimated cost information for each strategy, such as capital cost or net present value, depending on your preference and availability of information. The REDUCTIONS component will use this data to compute a unit cost of carbon emissions reduced in dollar per metric tonne of carbon dioxide equivalent (MTCO2e) based on the emissions reduction calculated in STEP 3. The estimated range of cost from the Fact Sheet is displayed for your reference.

Note: Cost information is not needed to use this feature of AirportGEAR. You can leave this information blank and still calculate estimated reductions in greenhouse gas emissions.

STEP 3: Enter Data for the Equation or Manually Enter Emission Reduction

To estimate potential greenhouse gas emission reductions that will result from implementing a strategy, you can utilize the equations that are provided, modify the equations that are provided or manually enter an emission reduction value that you estimated from another program, as described below.

Using the Equation that is Provided

The REDUCTIONS tab provides general equations to estimate the amount of greenhouse gas emissions that can be saved from implementing your selected strategies. Each equation contains a set of variables. While some default values are suggested for the variables, most of the needed information depends on the specific implementation details and must be provided by you. For example, if you plan to install solar panels, you will have to estimate how many kWh will be generated by the panels and provide the emission factors for your regional electricity grid. References are included to assist you in determining where to obtain the needed information and, in some cases, the references are provided in the LIBRARY tab of the **EXPLORE** feature of AirportGEAR. After you enter the variable values for a strategy, hit the "Calculate" button (located under the list of variables) to calculate the emission reduction.

If you are creating multiple plans and a particular strategy is included in more than one plan, you will only have to enter the variable values for that strategy's equations once. The variable values entered in the first plan will be carried over to the other plans that include that strategy. You will be able to change the variable values from plan to plan, but the repetition of the initial

values will prevent you from having to enter standard information more than once. For example, many strategies ask for the emission factors for the regional electricity grid. Once they are entered for a particular strategy in one plan, they will be copied into that strategy's equation in subsequent plans so that you do not have to repetitively enter this data.

These equations are for high-level planning; although it is important to accurately estimate the variable values, you can still benefit from these equations without detailed conceptual design data. By estimating the variable values for the equations at a high level, you can compare the benefits of the selected strategies to assist you in decision-making. Note that, because these equations are for high-level planning, they may not be appropriate for calculating a greenhouse gas inventory.

Equations are provided for most of the greenhouse gas reduction strategies, with the exception of those strategies that are strictly based on policy development or data collection and do not have equations to estimate the potential emission reductions. For example, one strategy includes developing a greenhouse gas inventory in order to identify the largest sources, and thus the best opportunities to reduce. Although a greenhouse gas inventory can help an airport determine which strategies are most appropriate for implementation, it does not directly lead to emission reductions and, therefore, an equation is not provided. For those strategies that do not have an equation, the following message will appear in the equation box:

"There is no generalized emission reduction equation available for this strategy. See the References note below for more details."

The "References note" provides detailed information regarding why an equation is not available for that strategy.

Modifying the Equation that is Provided

The REDUCTIONS component also allows the user to modify the equation if it changes over time or if a new equation becomes available. To modify an equation, click on the "Edit Formula" button (located under the list of variables). In the equation box, modify the equation by typing in the changes. The MATH EXPRESSIONS section can assist you in the proper equation syntax, if needed. After you have modified the equation, click on the "Check" button to validate the formula. A message indicating whether or not the formula is valid will appear under the list of variables. Finally, click on the "Exit Edit" button to complete the modification of the equation. You can reset the equation back to the original equation provided by AirportGEAR by clicking the "Reset" button.

Manually Enter the Value of the Emission Reduction

If you currently use another program to calculate potential greenhouse gas emission reductions, then you can manually enter the result in the space provided and bypass the equation. The benefit of manually adding this data into AirportGEAR is that you can see all potential emission reductions in one plan. For example, many airports use alternative programs to estimate energy savings and their related greenhouse gas emission reductions. If an airport is interested in looking beyond energy for greenhouse gas mitigation, the greenhouse gas savings from the energy programs can be manually entered into AirportGEAR and compared to other strategies that address topics such as ground transportation or airfield design for a comprehensive look at greenhouse gas emission reduction.

STEP 4: Allocate the Emissions Reduction to an Emission Source

To compare your baseline greenhouse gas inventory to the inventory that would result from implementing a selected strategy, you must allocate the emissions reduction to a specific emission source(s). The allocation is entered as a percentage of the emissions reduced. For example, if a strategy focuses on reducing electricity use, you can indicate that all of the saved electricity will be seen in the airport's purchased electricity by entering "100" in the box next to "Airport Sources – Purchased Electricity" (indicating that 100% of the reduction should be allocated to this source). Similarly, if the saved electricity is equally distributed for both the airport and the tenants, you can enter "50" in the boxes next to "Airport Sources – Purchased Electricity" and "Tenant Sources – Purchased Electricity" (indicating that 50% of the reduction should be allocated to each of these sources).

MATH EXPRESSIONS

The following steps outline how to use MATH EXPRESSIONS to modify an equation in the REDUCTIONS tab of **INVENTORY & REDUCTIONS**.

1. To edit a generalized emissions reduction formula for a particular strategy, select the strategy from the strategy list and then select the "Edit Formula" button below the formula text box.

2. The formula text box will be editable, allowing the user to edit the formula.

3. Additionally, the user can edit the unit value and description for each of the formula parameters below the formula.

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4. To validate changes, press the "Check" button. If the changes are valid, the "Check" button and the formula text box will be disabled indicating that the user can exit the formula editing session. The words "Formula valid" will appear under the list of variables.

5. To save the changes, press the "Exit Edit" button.

6. The user can now edit the values for each parameter in the formula, and the notes.

7. To calculate the results using the new information, press the "Calculate" button. The results will appear directly below the "Calculate" button.

8. To reset the equations back to the default expression, press the "Reset" button.

An expression is made up of Variables, Values, Operators, and/or Functions.

Variables are textual descriptions of values which can be inputted as values at a later time.

Values are constant and used as data in the formula at the time of formula creation.

Operators perform an action on the parameters or values to produce a new value.

Functions are predefined calculations.

Example formulas include:

1. $(A + B) / C * 100$

2. $sqrt(A^2 + B^2)$

3. $pi * r^2$

4. Cooling_Requirement * Equipment_Refrigerant_Charge * Global_Warming_Potential * 0.001

5. $pi*max(a+b + sin(z)/2^3-92.38*2, avg(b,a*90,33.333,12))$

The following is a list of Operators that may be used. The operators are a character or sequence of characters which can NOT be used as part of the expression parameters.

Operators	
+	Addition
-	Subtraction
/	Division
*	Multiplication
^	Raises x to the power of y
<	Less than
>	Greater than
==	Equal
!=	Not equal
>=	Greater or equal
and	Logical AND
or	Logical OR
xor	Logical XOR

General Functions		
sin - sine	cos -cosine	tan - tangent
asin - arc sine	acos -arc cosine	atan - arc tangent
sinh - hyperbolic sine	cosh - hyperbolic cosine	tanh - hyperbolic tangent
asinh - hyperbolic arc sin	acosh -hyperbolic arc cosine	atanh - hyperbolic arc tangent
log2 - logarithm base 2	log10 - logarithm base 10	log - logarithm
ln - logarithm to base e	exp - e raised to the power of x	sqrt - square root
sign - sign, -1 if x<0, 1 if x>0	rint - round to nearest integer	abs - absolute value
if - if..then..else	min - minimum of all arguments	max - maximum of all arguments
sum - sum of all arguments	avg - mean of all arguments	

Recommended Uses of INVENTORY & REDUCTIONS

Estimating potential emission reductions can help you select which strategies to fund and implement. After creating a plan in the **PLAN** feature and adding strategies to it from the LIST tab of **EXPLORE**, use **INVENTORY & REDUCTIONS** to estimate potential reductions for each strategy. Utilize the references in the LIBRARY tab in **EXPLORE** to look up emission factors that are commonly used in the equations in the REDUCTIONS tab. After the calculations are complete, print the "Detailed Report" and analyze the potential emissions reductions for each strategy in order to determine which strategies should be pursued.

Once the final list of strategies is selected and the plan is modified in **PLAN** by deleting those strategies that will not be implemented, enter baseline inventory data and evaluate how the reductions will impact the overall greenhouse gas footprint.

ADDENDUM 1: List of 125 Greenhouse Gas Emission Reduction Strategies

	Airfield Design and Operations
AF-01	Provide Infrastructure for Pre-Conditioned Air (PCA) and Ground Power
AF-02	Minimize the Use of Auxiliary Power Units (APUs)
AF-03	Design Airside Layout to Reduce Aircraft Delay and Surface Vehicle Congestion
AF-04	Design Runways, Taxiways, Ramps & Terminals to Reduce Aircraft Taxiing Distances
AF-05	Consider Longer Runways to Reduce the Use of Reverse Thrust
AF-06	Install or Expand Hydrant Fueling System
AF-07	Provide Fixed Gate Infrastructure for Aircraft Underground Supply and Evacuation Systems
AF-08	Create Partnerships with Intercity Rail Services to Optimize Passenger and Cargo Movement
AF-09	Implement Emission-based Incentives and Landing Fees
AF-10	Install a Jet Fuel Pipeline
AF-11	Support Optimized Departure Management on Existing Runways
AF-12	Support Modernization of Air Traffic Management (ATM)
AF-13	Support the Development of Alternative Fuels for Aircraft
AF-14	Support Single/Reduced Engine Taxiing
AF-15	Support Alternative Passenger Boarding Procedures
AF-16	Support Push Back Tugs to Transport Planes to Taxiways, Runway Ends and/or Take-off Areas
AF-17	Support Fuel Efficiency Targets for Aircraft
AF-18	Support the Use of Paperless Ticket Technology

	Business Planning
BP-01	Use Greenhouse Gas Impact Evaluations as Decision-Making Criteria
BP-02	Develop an Airport Expansion and Development Greenhouse Gas Emission Policy
BP-03	Develop a Climate Action Plan (CAP)
BP-04	Develop Climate Change and Energy Communication Materials and/or Information Center
BP-05	Create a Carbon Offset Purchasing Strategy
BP-06	Develop and Apply or Sell Carbon Offsets
BP-07	Offer Voluntary Carbon Offsets for Passengers
BP-08	Use Airport-Specific Sustainable Planning, Design, and Construction Guidelines
BP-09	Participate in a Greenhouse Gas Registry and/or Accreditation Program
BP-10	Set a Policy for Green Building Certification for Buildings
BP-11	Support the Use of Customer Self-Service Equipment in Terminal Design

Construction

CN-01   Use Warm Mix Asphalt (WMA) in place of Hot Mix Asphalt
CN-02   Recycle and Reuse Construction and Demolition Materials
CN-03   Implement a Construction Vehicle Idling Plan
CN-04   Specify Low-emission Construction Vehicles and Equipment
CN-05   Specify Energy Efficient Temporary Lighting During Construction

Carbon Sequestration

CS-01   Install Sustainable, Long-term Vegetation
CS-02   Add Mineral Carbonation Systems to Exhaust Streams
CS-03   Implement or Support Carbon Dioxide Capture and Storage Processes
CS-04   Invest in Terrestrial Carbon Sinks

Energy Management

EM-01   Develop a Strategic Energy Management Plan
EM-02   Specify Energy Efficiency Requirements for Equipment in Contract Agreements
EM-03   Develop Energy Performance Contracting Partnerships
EM-04   Enter into a Green Power Purchasing Agreement
EM-05   Evaluate "Take or Pay" Contract Provisions
EM-06   Develop and Market an Energy Conservation Program for Building Users
EM-07   Evaluate Fuel Mix
EM-08   Use Thermal Imaging to Identify Energy Losses
EM-09   Improve Insulation of Building Envelope
EM-10   Change Set Points or Exclude Selected Zones from Heating and Cooling
EM-11   Restrict Heating and Cooling to Lowest 10 ft of Indoor Space
EM-12   Install Green Vegetated Roofs for Greater Building Insulation
EM-13   Install a Cool Roof
EM-14   Design Building Orientation for Energy Use Reduction
EM-15   Apply Solar Reflective Paint
EM-16   Apply Thermochromic Coatings on Buildings
EM-17   Install LED Runway and Taxiway Lighting
EM-18   Implement a Lighting System Energy Conservation Program

Energy Management (cont.)

EM-19	Install a Building Automation System (BAS)
EM-20	Periodically Recommission HVAC Systems and Control Systems
EM-21	Install High-Efficiency Equipment and Controls
EM-22	Integrate Thermal Storage into Heating and Cooling Systems
EM-23	Evaluate and Upgrade the Central Plant and Distribution System Equipment
EM-24	Install Variable Speed Drives (VSD) and Optimize Controls of Pumps for Air Handling Units
EM-25	Install Evaporative Cooling Systems
EM-26	Install Energy Efficient Chillers
EM-27	Install Ultraviolet-C (UVC) Lights in Air Handling Units (AHUs) for Continuous Coil Cleaning
EM-28	Install a Heat Recovery System
EM-29	Design for Larger Diameter Piping
EM-30	Reduce Transmission Losses in Electrical Wires
EM-31	Purchase ENERGY STAR Equipment
EM-32	Enhance Piping Insulation
EM-33	Construct a Cogeneration or Trigeneration Energy System
EM-34	Use Methane from Anaerobic Bioreactor Treatment Systems for Deicing Fluids
EM-35	Install Energy Efficient Elevators, Escalators and Autowalks
EM-36	Optimize Passenger and Baggage Handling System
EM-37	Incorporate Use of Natural Ventilation and Economizer Control
EM-38	Install Window Awnings or Sunshades
EM-39	Utilize Sophisticated Energy Models for Building Design

Ground Service Equipment

GS-01	Support Alternatively Fueled Ground Service Equipment (GSE)

Ground Transportation

GT-01	Provide Priority Vehicle Parking for Emissions Friendly Vehicles
GT-02	Provide Preferential Car/Vanpool Parking for Employees
GT-03	Promote Public Transit to the Airport
GT-04	Provide Transit Fare Discounts and/or Alternative Mode Subsidies
GT-05	Increase Mass Transit Access to the Airport
GT-06	Alter Parking Pricing Structures for Employees and Passengers
GT-07	Implement "On-foot" Payment for Parking

Ground Transportation (cont.)

GT-08 Implement a Traffic Management System

GT-09 Allow Telecommuting for Employees

GT-10 Allow Flexible Work Schedules for Employees

GT-11 Build a Consolidated Rent-A-Car Facility (ConRAC)

GT-12 Construct a Personal Rapid Transit (PRT) System

GT-13 Promote Bicycle Use by Employees

GT-14 Convert Airport Fleet Vehicles to Alternatively Fueled Vehicles

GT-15 Support Conversion of Tenant Fleet Vehicles to Alternatively Fueled Vehicles

GT-16 Support Alternatively Fueled Vehicles for Rental Cars and Commercial Vehicles

GT-17 Support Alternatively Fueled Taxis

Materials and Embedded Energy

ME-01 Develop an Integrated Solid Waste Management Plan

ME-02 Start or Enhance a Waste Reduction or Recycling Program

ME-03 Start or Enhance a Green Procurement Program (GPP)

ME-04 Separate and Compost Food Waste

Operation and Maintenance

OM-01 Create a Detailed Operations and Maintenance Manual

OM-02 Develop a Measurement and Verification Plan

OM-03 Use a Computerized Maintenance Management System (CMMS)

Performance Measurement

PM-01 Conduct Regular Greenhouse Gas (GHG) Emission Inventories

PM-02 Perform Energy Audits

PM-03 Install Tenant Energy Sub-Metering Systems

PM-04 Track Energy Use

PM-05 Work with Airport Industry to Develop Benchmarking Databases

Renewable Energy (on-site)

RE-01   Install Building Integrated Photovoltaic (BIPV) Panels
RE-02   Install Building-mounted or Ground-mounted Solar Photovoltaic (PV) Panels
RE-03   Install Solar Thermal Systems for Hot Water Production
RE-04   Use Solar Desiccant Air Conditioning Systems
RE-05   Use On-site Biomass Energy Systems
RE-06   Install Ground-Source or Geothermal Heating and Cooling System
RE-07   Install a Geothermal Snow and Ice Melting System
RE-08   Use Seawater and Natural Water Bodies for Cooling
RE-09   Install Building-Mounted Wind Turbines
RE-10   Install a Waste-to-Energy System
RE-11   Install a Tidal Energy System
RE-12   Install Sewer Heat Recovery Systems
RE-13   Construct a Hydrogen Fueling and Generation Station
RE-14   Utilize Local Landfill Gas

Refrigerants

RF-01   Replace Refrigerants with Natural or Lower Global Warming Potential (GWP) Gases
RF-02   Incorporate Intelligent Fault Diagnosis for HVAC Refrigerant Systems
RF-03   Use Hydronically Coupled Vapor-Compression Heat Pumps
RF-04   Install Microchannel Components and Heat Exchangers

ADDENDUM 2: Evaluation Criteria

Evaluation Criteria and Their Rating Values

Financial Considerations				
		Rating Values		
Criterion	Definition	Icon	Numerical Score in AirportGEAR*	Rating Value Definitions
Estimated Capital Costs	Upfront costs to plan, design and/or construct the reduction action.	$	1	< $10,000
		$$	2	$10,000 - $100,000
		$$$	3	$100,001 - $1,000,000
		$$$$	4	> $1,000,000
Estimated Annual Operations and Maintenance Costs	Annual costs for continued implementation of the reduction action.	🔧	1	< $5,000
		🔧🔧	2	$5,000 - $50,000
		🔧🔧🔧	3	$50,001 - $100,000
		🔧🔧🔧🔧	4	> $100,000
Estimated Payback Period**	The time required for the return on an investment to "repay" the capital and operations and maintenance costs.	📅	1	< 2 years
		📅📅	2	2 - 5 years
		📅📅📅	3	6 - 10 years
		📅📅📅📅	4	> 10 years

* For "Estimated Capital Cost," "Estimated O&M Cost" and "Estimated Payback Period," AirportGEAR transforms the numerical scores shown here to complete the calculation of the overall numerical score for the strategy. When computing the overall numerical score for the strategy, AirportGEAR reverses the scores for these criteria (e.g. one dollar sign is represented at "4" in the overall numerical score calculation instead of "1") to reflect that higher scores are more desirable. The user does not need to do anything different based on this information; this reversal of scores is done in the background of the tool and is represented in the overall numerical score for the strategy. The user should use the numerical scores shown in this table when interpreting or changing the rating values for these evaluation criteria in AirportGEAR.

** Does not consider financial incentives such as grants, rebates or tax incentives or the cost of carbon.

Evaluation Criteria and Their Rating Values

Implementation Considerations				
Criterion	Definition	Rating Values		
		Icon	Numerical Score in AirportGEAR	Rating Value Definitions
Airport Control***	The level of financial and logistical control of the airport operator to implement the reduction action.	✈	1	Airport operator has no ownership, control, or influence over implementation of the strategy
		✈✈	2	Airport operator has no ownership or control, but can influence the reduction of GHG emissions through policy, procedures or training
		✈✈✈	3	Airport has no ownership or control, but can influence the reduction of GHG emissions through infrastructure improvements
		✈✈✈✈	4	Airport operator has complete control over implementation of strategy
Implementation Timeframe	The time period required to implement the action and reduce GHG emissions.	◷	1	Immediate: < 1 yr
		◷◷	2	Short-term: 1 - 5 yrs
		◷◷◷	3	Medium-term: 5 - 10 yrs
		◷◷◷◷	4	Long-term: > 10 yrs
Maturity of Strategy	Past demonstration that the reduction action is implementable and effective.	★	1	Conceptual stage
		★★	2	Trial tested
		★★★	3	Proven
		★★★★	4	Proven at airports

*** Ranking scale is representative of a majority of airports, but may not fit the control and operation structure for every airport

Evaluation Criteria and Their Rating Values

Potential Impacts				
		Rating Values		
Criterion	Definition	Icon	Numerical Score in AirportGEAR	Rating Value Definitions
GHG Reduction Potential: *Scopes 1 & 2 ****	The magnitude of the reduction in Scope 1 & 2 GHG emissions (Direct and Indirect emissions) as a result of the action.	*None*	0	Does not decrease Scopes 1 &2 emissions
			1	Low: Reduction of Scopes 1 & 2 emissions is always relatively low
			2	Medium: There is potential for the reduction of Scopes 1 & 2 emissions to range from low to high depending on implementation details
			3	High: Reduction of Scopes 1 & 2 emissions is always relatively high
GHG Reduction Potential: *Scope 3 ****	The magnitude of the reduction in Scope 3 GHG emissions (Other emissions) as a result of the action.	*None*	0	Does not decrease Scope 3 emissions
			1	Low: Reduction of Scope 3 emissions is always relatively low
			2	Medium: There is potential for the reduction of Scope 3 emissions to range from low to high depending on implementation details
			3	High: Reduction of Scope 3 emissions is always relatively high
Impacts to Natural Resources	Impacts or secondary benefits to natural resources.		2	Adverse impacts to natural resources (i.e. stormwater)
			0	No benefit or impact to natural resources
			-2	Benefit to natural resources (i.e. reduces criteria pollutants)
Impacts to the Built Environment	Secondary benefits for the built environment and local communities.		2	Adverse impacts to the built environment
			0	No adverse or positive impacts to the built environment
			-2	Positive impact to the built environment
Impacts to Regulatory Compliance	Impact on the airport operator's compliance status with regulations.		2	May trigger a change to regulatory compliance status
			0	Does not change regulatory compliance status
			-2	May facilitate compliance with a regulation

*** Ranking scale is representative of a majority of airports, but may not fit the control and operation structure for every airport

ADDENDUM 3: Examples of Reports Generated by the PLAN Feature

Summary Report:
Greenhouse Gas Emission Reduction Strategies

This Summary Report presents the greenhouse gas (GHG) emission reduction strategies that were selected through the use of "AirportGEAR", a tool developed by ACRP Project 02-10, "Practical Greenhouse Gas Emissions Reduction Strategies for Airports." This Summary Report presents technical information for each strategy that is intended to assist in decision-making activities related to GHG emission reduction at a specific airport facility or for a specific project.

Airport Name:	*Sunshine Airport*
Plan Name:	*Development of a Consolidated Rent-A-Car Facility (ConRAC)*
Description:	*This plan summarizes the GHG emission reduction strategies for consideration for the ConRAC project.*
Notes:	*This plan includes the garages, parking lots and buildings associated with the ConRAC. It also includes the enabling project that changes the roadways to re-route ground transportation vehicles.*

Selected GHG Emission Reduction Strategies

Strategy Number	Strategy Name	Category	Score (1)	Potential Impacts to: Scope 1	Scope 2	Scope 3
BP-10	Set a Policy for Green Building Certification for Buildings	Business Planning	76	☒	☒	☒
BP-01	Use Greenhouse Gas Impact Evaluations as Decision-Making Criteria	Business Planning	73	☒	☒	☒
RE-01	Install Building Integrated Photovoltaic (BIPV) Panels	Renewable Energy (on-site)	66	☐	☒	☒
EM-15	Apply Solar Reflective Paint	Energy Management	63	☒	☒	☒
GT-08	Implement a Traffic Management System	Ground Transportation	62	☒	☐	☒
GT-16	Support Alternatively Fueled Vehicles for Rental Cars and Commercial Vehicles	Ground Transportation	61	☐	☐	☒
EM-12	Install Green Vegetated Roofs for Greater Building Insulation	Energy Management	59	☒	☒	☒
GT-11	Build a Consolidated Rent-A-Car Facility (ConRAC)	Ground Transportation	48	☐	☐	☒

(1) - The score is the sum of the strategy's criteria rating values, weighted against the selected priority preferences. The scores have been further normalized to fall in a range between 0 and 100.

Detailed Report:
Greenhouse Gas Emission Reduction Strategies

This Detailed Report presents the greenhouse gas (GHG) emission reduction strategies that were selected through the use of "AirportGEAR," a tool developed by ACRP Project 02-10, "Practical Greenhouse Gas Emissions Reduction Strategies for Airports." This Detailed Report presents technical information for each strategy and data related to the airport's GHG inventory that is intended to assist in decision-making activities related to GHG emission reduction at a specific airport facility or for a specific project.

Airport Name: *Snowy Airport*

Plan Name: *Energy Management Program*

Description: *This plan summarizes strategies to reduce energy use and associated GHG emissions on the entire airport property.*

Notes: *This plan includes both airport operator spaces and tenant spaces. The primary goals of the program are to save energy and reduce annual energy costs.*
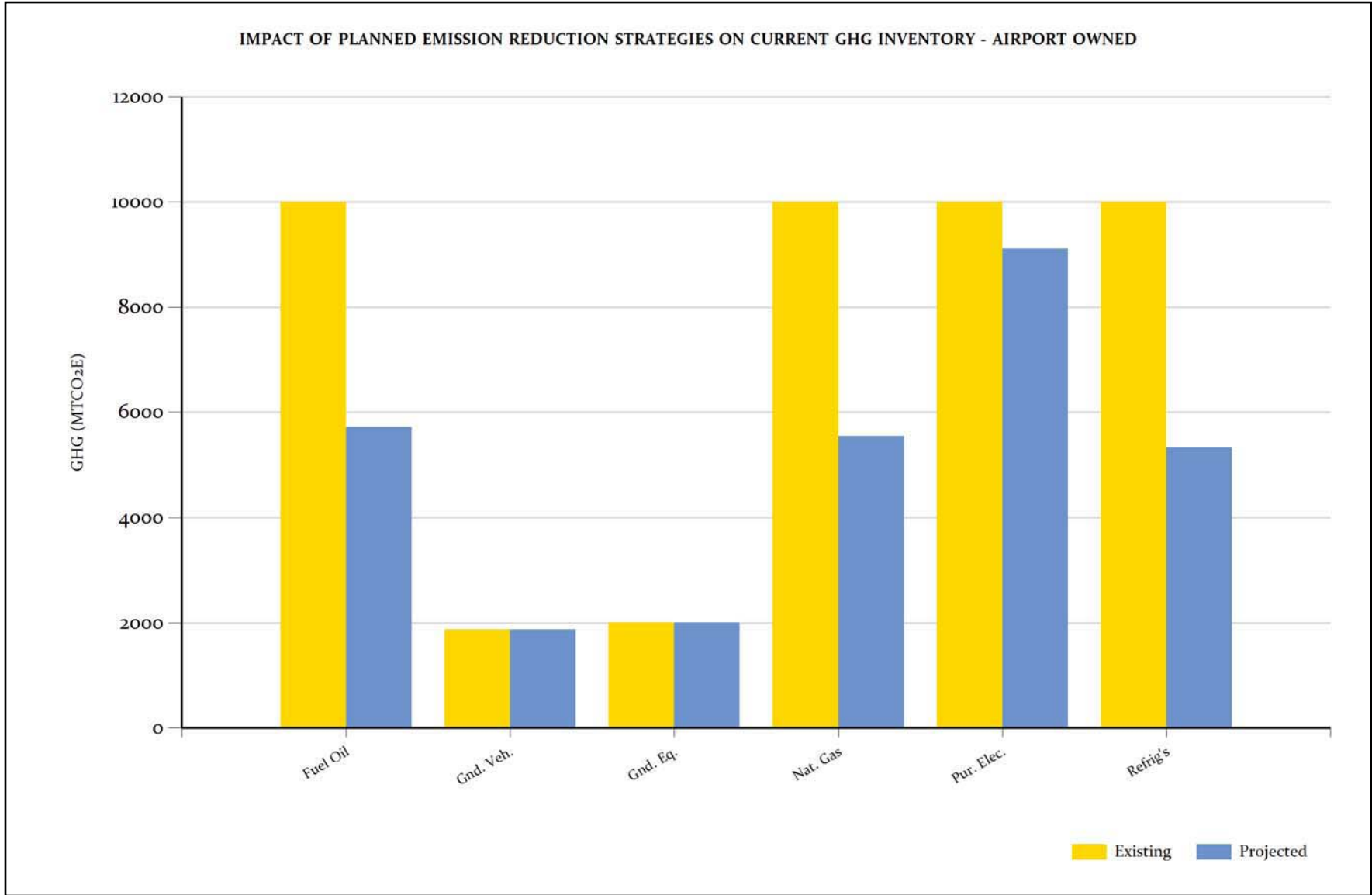
Selected GHG Emission Reduction Strategies

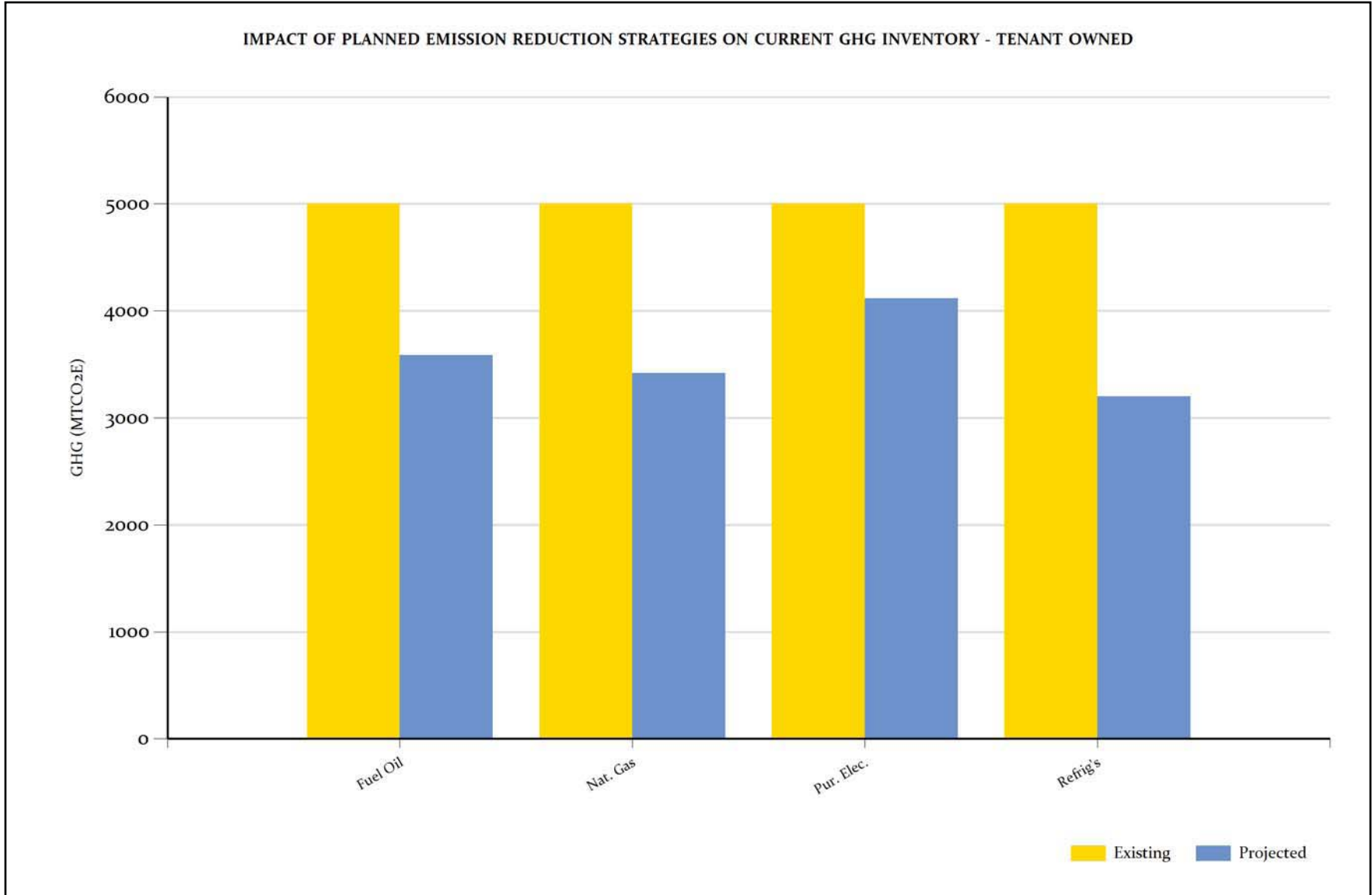| Strategy Number	Strategy Name	Category	Score (1)	Emission Reduction (MTCO2e)	Cost ($)	Unit Cost ($/MTCO2e)	Potential Impacts to: Scope 1	Scope 2	Scope 3
RF-01	Replace Refrigerants with Natural or Lower Global Warming Potential (GWP) Gases	Refrigerants	81	3,240	15,000	4.6	☒	☐	☒
RF-02	Incorporate Intelligent Fault Diagnosis for HVAC Refrigerant Systems	Refrigerants	79	3,600	7,500	2.1	☒	☒	☒
RF-04	Install Microchannel Components and Heat Exchangers	Refrigerants	78	2,500	50,000	20.0	☒	☒	☒

Strategy Number	Strategy Name	Category	Score (1)	Emission Reduction (MTCO2e)	Cost ($)	Unit Cost ($/MTCO2e)	Scope 1	Scope 2	Scope 3
EM-06	Develop and Market an Energy Conservation Program for Building Users	Energy Management	75	625	7,500	12.0	☒	☒	☒
EM-08	Use Thermal Imaging to Identify Energy Losses	Energy Management	75	N/A			☒	☒	☒
EM-10	Change Set Points or Exclude Selected Zones from Heating and Cooling	Energy Management	75	1,440	5,000	3.5	☒	☒	☒
EM-09	Improve Insulation of Building Envelope	Energy Management	74	900	10,000	11.1	☒	☒	☒
EM-38	Install Window Awnings or Sunshades	Energy Management	74	28	25,000	892.9	☒	☒	☒
EM-07	Evaluate Fuel Mix	Energy Management	71	2,039	750,000	367.8	☒	☐	☒
EM-02	Specify Energy Efficiency Requirements for Equipment in Contract Agreements	Energy Management	66	N/A			☒	☒	☒
EM-26	Install Energy Efficient Chillers	Energy Management	66	15	100,000	6,666.7	☒	☒	☒
EM-32	Enhance Piping Insulation	Energy Management	64	1,730	50,000	28.9	☒	☒	☒
EM-01	Develop a Strategic Energy Management Plan	Energy Management	63	N/A			☒	☒	☒
EM-35	Install Energy Efficient Elevators, Escalators and Autowalks	Energy Management	62	19	250,000	13,157.9	☐	☒	☒
EM-20	Periodically Recommission HVAC Systems and Control Systems	Energy Management	60	1,080	100,000	92.6	☒	☒	☒
EM-23	Evaluate and Upgrade the Central Plant and Distribution System Equipment	Energy Management	59	5,729	1,000,000	174.6	☒	☒	☒

Detailed Report: Energy Management Program

Strategy Number	Strategy Name	Category	Score (1)	Emission Reduction (MTCO2e)	Cost ($)	Unit Cost ($/MTCO2e)	Potential Impacts to:		
							Scope 1	Scope 2	Scope 3
EM-27	Install Ultraviolet-C (UVC) Lights in Air Handling Units (AHUs) for Continuous Coil Cleaning	Energy Management	59	259	50,000	193.1	☒	☒	☒
EM-34	Use Methane from Anaerobic Bioreactor Treatment Systems for Deicing Fluids	Energy Management	51	2,557	1,000,000	391.1	☒	☒	☒

(1) - The score is the sum of the strategy's criteria rating values, weighted against the selected priority preferences. The scores have been further normalized to fall in a range between 0 and 100.

IMPACT OF PLANNED EMISSION REDUCTION STRATEGIES ON CURRENT GHG INVENTORY - AIRPORT OWNED

IMPACT OF PLANNED EMISSION REDUCTION STRATEGIES ON CURRENT GHG INVENTORY - TENANT OWNED

Awareness Presentation

A slide presentation of awareness training materials that can be used by airports to educate and inform stakeholders is available on the attached CD-ROM.

Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation