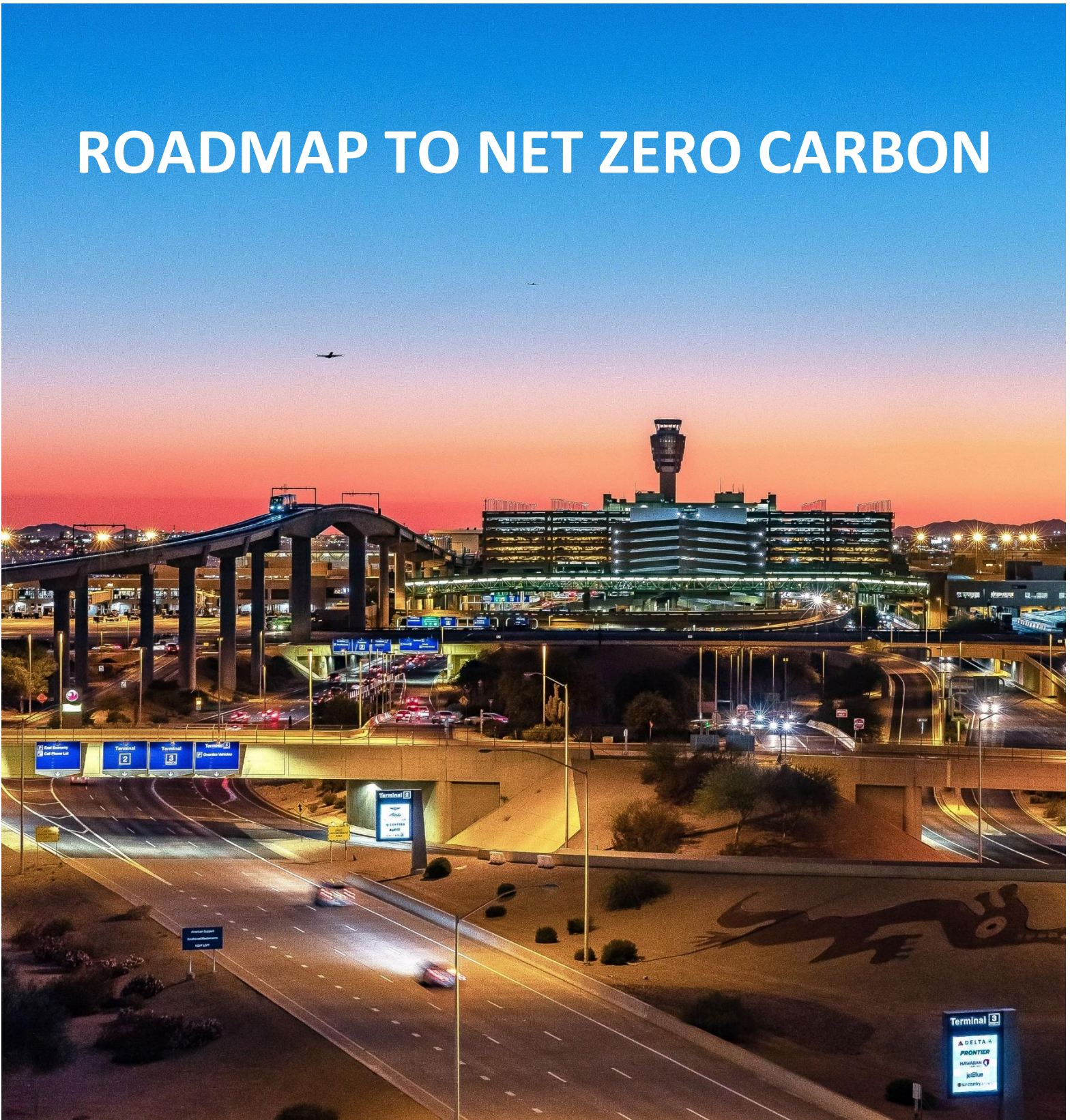


# ROADMAP TO NET ZERO CARBON



**PHX DVT 6YR**  
FUTURE FRIENDLY: AVIATION SUSTAINABILITY



# LETTER FROM THE DIRECTOR

Over the past few years, we have seen compounding challenges related to extreme weather events, fuel shortages, and energy security issues, revealing that a transition to a net zero carbon energy system is now more important than ever. Worldwide, an overwhelming number of businesses and governments have come to recognize their responsibilities for addressing their contributions to climate change. And the United Nations Framework Convention on Climate Change (UNFCCC) established an ambitious goal to achieve net zero carbon emissions by the year 2050.



The aviation industry is a world leader in the provision of safe, secure, and efficient transportation. However, our industry alone is responsible for approximately 2.5% of global carbon emissions—a significant statistic considering nearly 80% of the world's population has never experienced air travel. Accordingly, our industry takes its responsibilities for ensuring the provision of a clean, healthy, equitable, and sustainable environment seriously. Following the goals set by the UNFCCC, Airports Council International developed a long-term carbon reduction program for airports to eliminate airport-controlled carbon emissions and to work with airport users and stakeholders to reduce their carbon emissions from operations at the airports.

As the front door to the greater Phoenix community, the City of Phoenix Aviation Department is committed to doing our part to achieve net zero carbon emissions. As outlined in our Sustainability Management Plan posted on [skyharbor.com](https://www.skyharbor.com), we have a proud history of accomplishing many notable sustainability actions, and we will continue to focus on future friendly initiatives that drive meaningful results and reduce our footprint.

With this Roadmap to Net Zero Carbon, the Aviation Department will continue to lead through our commitment to reaching net zero carbon emissions by 2040—only 18 years from today, and a decade ahead of global and industry goals. It represents a determined pathway to a clean, efficient, and resilient energy system prioritizing renewable energy resources over fossil fuels. Our commitment requires an all-hands-on-deck approach—from airport staff and business partners to our valued passengers and the surrounding community. We request and welcome your thoughtful engagement on this serious issue.

This Roadmap is a bold and visionary plan and should be considered a living document as some technologies needed to fully decarbonize our industry are still emerging. Therefore, we commit to regularly updating this Roadmap to celebrate our successes, highlight unforeseen challenges, and showcase new innovations.

We plan to use this document as a unifying foundational vision for all decarbonization activities moving forward and for engaging our airport stakeholders to do the same.

Change is needed. And with change, comes opportunity. This Roadmap is a call to action that makes the Phoenix Aviation Department a leader in the airport industry. I look forward to working with each of you as we drive to Net Zero Carbon.

# ACKNOWLEDGEMENTS

This Roadmap to Net Zero Carbon was made possible through the contributions of many dedicated individuals.

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We wish to acknowledge the City of Phoenix Office of Environmental Programs and Sustainability as well as the City Manager's office. Without their support and contributions this plan would not be possible.

For questions, please contact us at <https://comments.skyharbor.com/hc/en-us>.

# EXECUTIVE SUMMARY

This Roadmap to Net Zero Carbon (the **Roadmap**) was developed for the City of Phoenix (City), Aviation Department for the purpose of achieving the ambitious goal of net zero carbon (i.e., greenhouse gas) emissions by 2040. The Roadmap builds on decades of climate protection efforts by the City and the Aviation Department, as a demonstrated leader in the aviation industry. Since the 2010 baseline year, the Aviation Department has reduced annual carbon emissions 34% through energy conservation measures (ECMs) and on-site renewable energy (i.e., solar) development, among other initiatives. To achieve net zero carbon, the Aviation Department seeks to reduce nearly 70,000 metric tons (MT) of carbon emissions as much as feasible before pursuing carbon removal technologies to account for residual emissions.

This Roadmap identifies the short-, medium- and long-term strategies for the Aviation Department to reach this goal. As electricity accounts for nearly 90% of Aviation Department emissions, the single most important strategy is the development of a carbon-free energy system in the short-term. The Roadmap calls for reducing electricity demand through implementing high-impact ECMs, developing additional on-site solar and financing renewable energy. By 2040, the Roadmap identifies addressing emission sources that are more difficult to decarbonize, such as airport-owned fleet vehicles, natural gas used in buildings, refrigerants and airport staff business travel, before pursuing carbon removal technologies for residual emissions. The Roadmap then includes maintaining the net zero carbon status long-term to ensure a sustained approach. As emissions are also generated from third parties (e.g., tenants) that are outside of the Aviation Department’s direct control, the Roadmap identifies strategies for developing partnerships on emission reduction initiatives.

STRATEGIES	EMISSIONS IMPACT	TIMELINE							
		Today	2025	2030	2035	2040	2045	2050	
<p><b>SHORT-TERM:</b> <i>Build momentum for net zero through high-impact strategies</i></p> <ul style="list-style-type: none"> <li>• Energy Conservation Measures</li> <li>• Solar Energy Development</li> </ul>	<p>+++</p> <p>++++</p>	█		█					
<p><b>MEDIUM-TERM:</b> <i>Address sources that are harder to decarbonize and balance residual emissions</i></p> <ul style="list-style-type: none"> <li>• Fleet Transition</li> <li>• Natural Gas Transition</li> <li>• Refrigerant Management</li> <li>• Airport Staff Business Travel</li> <li>• Carbon Removal Technologies</li> </ul>	<p>++</p> <p>+</p> <p>+</p> <p>+</p> <p>+</p>	█				█			
<p><b>LONG-TERM:</b> <i>Maintain net zero status</i></p>	<p>+</p>					█ →			

Net Zero Carbon Strategies

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# INTRODUCTION

The latest report by the Intergovernmental Panel on Climate Change demonstrated limiting global warming to 1.5°C (2.7°F) is necessary to avoid major negative climate impacts. This requires the global community to reach net zero carbon by 2040 for human-induced emissions (IPCC 2022). Governments and organizations are quickly re-aligning around this latest science. For example, an Oxford-based study found that one fifth of the 2,000 largest public companies had net zero carbon commitments (Black 2021). The aviation industry is also embracing net zero carbon concepts. In 2021, the Federal Aviation Administration released an Aviation Climate Action Plan that lays the groundwork for achieving net zero carbon for aircraft emissions by 2050 (FAA 2021) and, in 2022, launched an Airport Climate Challenge to support airport net zero carbon goals (FAA 2022). Similarly, the International Air Transport Association approved a resolution for the global air transport industry to achieve net zero carbon by 2050 (IATA 2021).

Within the City a high emphasis is placed on climate protection, as evidenced by decades of climate planning and carbon emission reduction efforts. In 2020, the City joined the C40 Cities Climate Leadership Group, a network of the world's major cities committed to addressing climate change. Through concerted efforts of City departments stakeholders and the public, the 2021 City of Phoenix Climate Action Plan (CAP) was developed, laying out substantive actions to achieve carbon neutrality city-wide by 2050.

Building on these efforts as well as advances in the aviation industry, the Aviation Department has focused on carbon emission reductions for the Aviation Department's three airports: Phoenix Sky Harbor International Airport (Sky Harbor), Phoenix Deer Valley Airport (Deer Valley), and Phoenix Goodyear Airport (Goodyear). The Aviation Department has continuously demonstrated its climate leadership within the airport community, with accomplishments highlighted in Figure 1. For example, Sky Harbor was one of the first airports in the United States to become certified in Airports Council International's (ACI's) Airport Carbon Accreditation (ACA) program, the only global carbon management certification program for airports. Sky Harbor achieved Level 2 certification in 2016 and is finalizing the certification for Level 4, an accomplishment achieved by only one airport in North America.



Figure 1. Aviation Department Accomplishments

# ROADMAP VISION

With this Roadmap, the Aviation Department commits to a simple yet sweeping goal: net zero carbon by 2040. This goal is defined by an absolute reduction of Aviation Department carbon emissions by at least 90% from a 2010 baseline with no more than 10% of emissions eliminated through carbon removal technologies.

In alignment with the City’s CAP, the Aviation Department has identified the following CAP targets to serve as interim milestones to achieve the long-term net zero carbon goal:

- Reduce carbon emissions from City operations 40% by 2025, compared to 2005.
- Achieve carbon-free electricity by 2030.
- Increase efficiency of buildings by 30% by 2030, compared to 2012.

Following achievement of the net zero carbon goal in 2040, the Aviation Department will maintain the net zero carbon status. The Aviation Department will also continue to support the CAP efforts, including achieving the following long-term CAP target:

- Design and construct facilities to the Living Building Challenge or equivalent design standards by 2050.

## WHAT IS NET ZERO CARBON?

ACI’s Long-term Carbon Goal Study for Airports (ACI 2021) defines net zero carbon as achieving the maximum feasible absolute emission reductions and using carbon removal technologies to account for an equal volume of residual emissions. The Science-based Target Initiative (SBTi 2022) further requires that no more than 10% of emissions are accounted for with carbon removal technologies.

Importantly, the definition provided by ACI, as well as CDP and C40 Cities utilized by the City, does not allow for conventional carbon offsets. The difference between offsets and carbon removal technologies is detailed below:

- **Carbon offsets:** Financing off-site projects that reduce carbon emissions that would not have otherwise been implemented.
- **Carbon removal technologies:** Financing projects that remove carbon from the atmosphere and permanently store it in geological, terrestrial or ocean reservoirs, or in products. Carbon removal technologies include nature-based solutions like afforestation and soil carbon sequestration as well as engineered approaches like direct air capture and enhanced mineralization. This is an emerging market that is currently taking shape.

# CHALLENGES

Pursuit of a net zero carbon goal requires clear-eyed appreciation of the challenges ahead. These challenges include:

- **Maintaining funding.** Investments in certain emission reduction strategies will require dedicated funding. Further, some investments require higher upfront costs but produce later operational savings.
- **Stock turnover rates.** Many of the Aviation Department assets that use energy have a long service life. For example, a fleet inventory typically has a service life of 10 to 15 years, which impacts the speed at which decarbonization can occur.
- **Reliance on emerging technologies.** Each year new technologies come on-line and become common place, thus redirecting the focus of net zero carbon projects. The Roadmap uses assumptions about the availability and affordability of technology in the future, such as electric or hydrogen-powered heavy-duty vehicles, renewable natural gas, and high-quality carbon removal technologies.
- **Long-term stakeholder coordination.** Rarely are projects implemented over a multidecade time period. The political regulatory environment and policies are subject to change throughout this duration. This Roadmap requires coordination with many key stakeholders, including not only staff, practitioners, tenants, and third-party users of the airports, but also elected officials, utility providers and the broader community.
- **Shifting consensus on the science.** The technology and related science around net zero carbon continues to evolve, creating a level of uncertainty. Furthermore, carbon emission accounting continues to become more accurate, driving the need for inventory and pathway changes.

# OUR SOLUTION

This Roadmap is the culmination of months of effort by airport staff using rigorous analytical tools and input from stakeholders, as defined by the *Roadmapping Process*. As the basis for analyzing emissions and monitoring progress, the *Baseline Emissions* was developed for all 3 airports. The forward-looking *Net Zero Carbon Pathway* describes the approach for reaching the net zero carbon goal followed by descriptions of the *Net Zero Carbon Strategies*. Each strategy has a corresponding start and end date, cost, and emission reduction estimate further detailed in **Appendix A**. Many of these actions build upon existing initiatives identified in the City's CAP and will be shaped alongside future planning efforts.

At a high level, the path to net zero carbon is simple: implement ECMs, decarbonize electricity, transition end uses to renewable energy, and eliminate a small quantity of residual emissions through carbon removal technologies. The strategies are designed to tackle the largest emission source first: electricity. This will build momentum and ensure operational savings that can be re-invested. For the medium- and long-terms, the Roadmap focuses on continuing to reduce emissions from sources that are more difficult to decarbonize, partnering with third parties on emissions reductions, as outlined in **Appendix B** and maintaining the net zero status.



# ROADMAPPING PROCESS

## TASK FORCE

For development of this Roadmap, a Task Force was formed, comprised of approximately 20 key stakeholders across the Aviation Department. Members were charged with guiding development of the Roadmap and ensuring alignment on development of policy and implementation pathways. The Task Force provided both ground-truthing and brainstorming to develop the Roadmap content, with meetings highlighted in Figure 2.

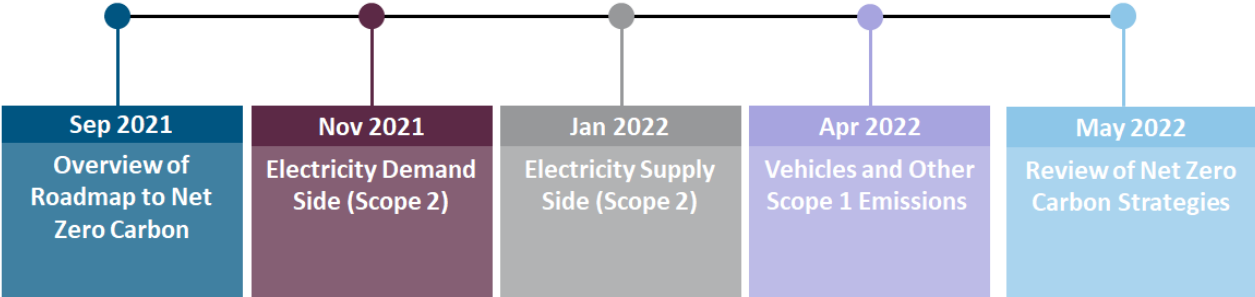


Figure 2. Task Force Meetings

## FOCUS GROUPS

In addition to the Task Force, Aviation Department staff held focus groups on specific topics throughout early 2022. These focus groups were comprised of approximately five to ten technical staff who discussed detailed considerations, key issues, timing implementation, budgeting, and other quantitative analysis.

## ANALYTICAL TOOL

The consultant team developed a forward-looking analytical tool that documents existing Baseline Emissions and charts the pathway for projected emissions by assessing emissions reduction and costs of various scenarios between today and 2040. The tool captures interactions between emission sources, such that changes in one factor—such as carbon intensity of fuels, technology mix, energy demand, and the impact of other factors—are revealed. For example, the tool captures the increase in electricity consumption from vehicle electrification and the simultaneous decrease in consumption from the implementation of ECMs, as highlighted in Figure 3.

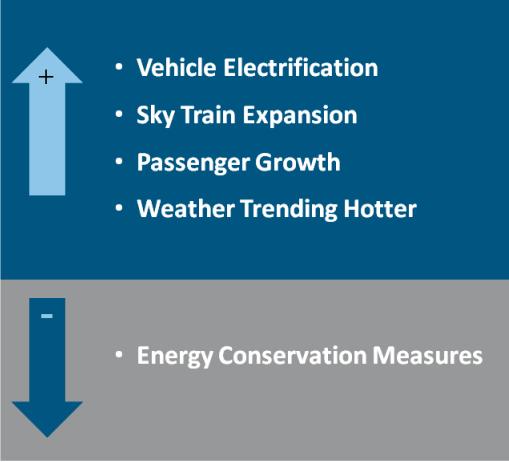


Figure 3. Electricity Consumption Changes Over Time

The tool combines data from today with assumptions about future conditions to estimate financial and emission-related outputs, as illustrated in Figure 4. Together, the tool allows a year-by-year projection of energy and emissions across a range of potential inputs. The airport staff used the tool to develop a number of scenarios which were discussed with the Task Force and Focus Groups, and ultimately, build the *Net Zero Carbon Pathway*.

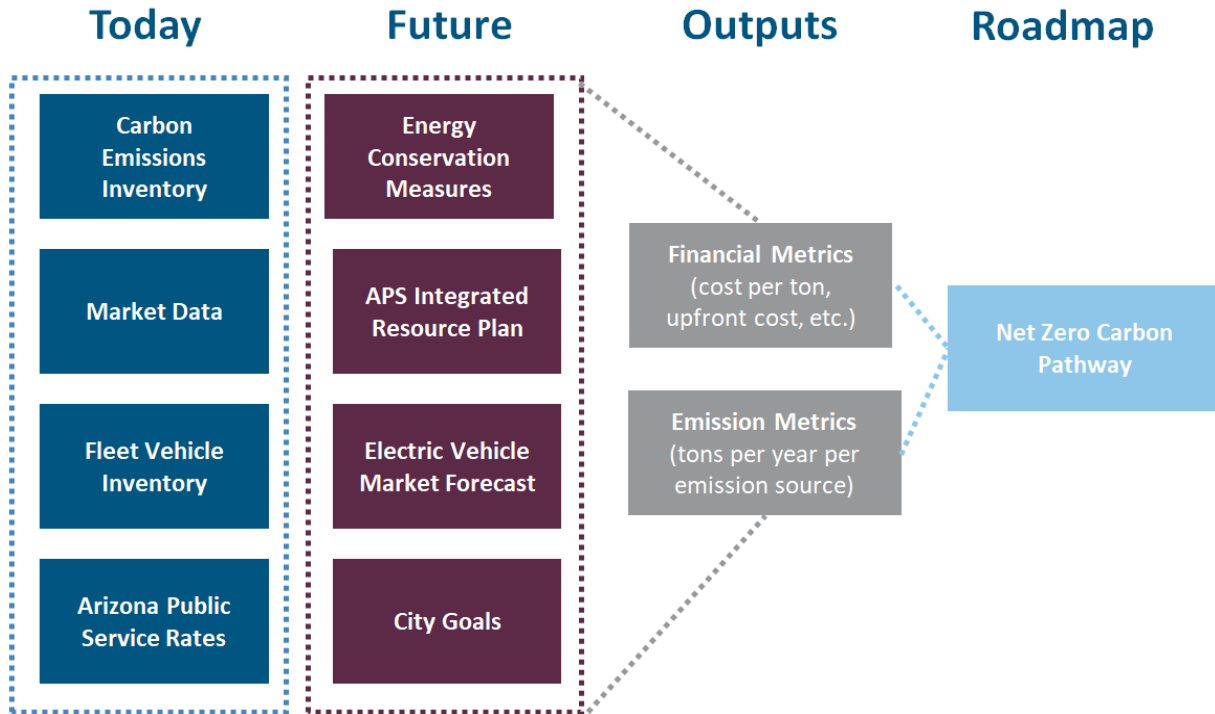


Figure 4. Analytical Tool Concept



# BASELINE EMISSIONS

To standardize emission reporting, the airport community follows the carbon emission inventory methodology defined by the ACA Program that is based on the GHG Protocol (World Resources Institute 2021) yet adapted for the complexities of the airport environment. While this methodology differs from the methodology utilized for the city- and community-wide inventories, it allows for comparison within the aviation industry.

The emission source scopes are defined by the ACA Program as follows:

- **Scope 1.** Direct emissions from airport-controlled sources, including the airport vehicle fleet and emergency generators (Fleet & Equipment); refrigerants used in airport equipment and natural gas used in airport buildings (Buildings-NG).
- **Scope 2.** Indirect emissions from the purchase of electricity for use by the airport.
- **Scope 3.** Indirect emissions from third parties, including aircraft ground operations and flights; aircraft ground support equipment; third-party vehicles operating on-site; passenger transportation (i.e., cars, taxis, buses, shuttles, etc.); airport and third-party staff and visitor transportation; off-site waste and wastewater management; tenant electricity use; tenant natural gas use; deicer application; construction; and airport staff business travel.

In accordance with the ACA guidance, the Aviation Department's goal applies to scope 1 and scope 2 carbon emissions as well as scope 3 airport staff business travel only (collectively referred to as Aviation Department emissions).

## BASELINE INVENTORY

The Aviation Department's baseline emissions inventory, depicted in Figure 5, serves as a benchmark for monitoring progress. The inventory was prepared using ACI's Airport Carbon and Emissions Reporting Tool (ACERT) for the 2010 calendar year, as required by the ACA program, and includes emissions from Sky Harbor, Goodyear and Deer Valley.

In 2010, the Aviation Department generated 103,820 MT of carbon emissions, expressed as carbon dioxide equivalents (CO<sub>2</sub>e). Nearly 90% of Aviation Department emissions were derived from the purchase of electricity (scope 2) and 10% from fleet and equipment. The remaining emissions came from natural gas used in buildings (i.e., buildings-NG), refrigerants and airport staff business travel, with each source comprising 1% or less of total Aviation Department emissions.

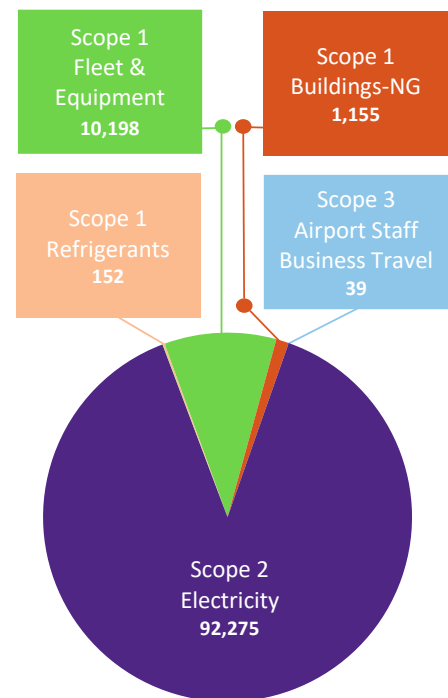
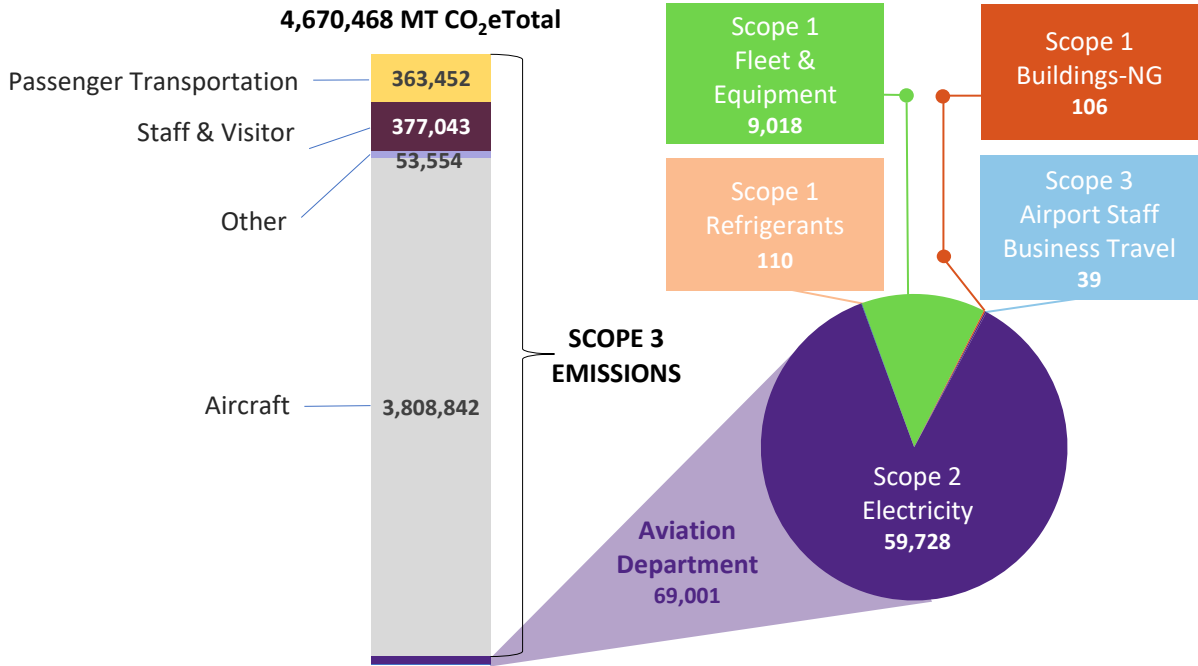


Figure 5. Aviation Department 2010 Baseline Emissions (MT CO<sub>2</sub>e)

# PROGRESS INVENTORY

Considering the many advances since the baseline year, the Aviation Department’s 2021 inventory, summarized as Figure 6, was developed as the basis for analyzing existing conditions and projecting the *Net Zero Carbon Pathway*. In 2021, the Aviation Department generated 69,001 MT CO<sub>2</sub>e, demonstrating an annual reduction of 34,819 MT CO<sub>2</sub>e (i.e. 34%) since the 2010 baseline. The percent contribution of each emission source was roughly consistent with the 2010 baseline. In monitoring progress towards the interim milestone to reduce carbon emissions 40% by 2025 compared to a 2005 baseline (i.e., a target of 58,449 MT CO<sub>2</sub>e), Aviation Department emissions have been reduced by 30%.

As required by the ACA program for achieving Level 4, the 2021 inventory was expanded to include scope 3 emissions at Sky Harbor for analysis purposes. Future inventories will be expanded to also include complete scope 3 emissions at Goodyear and Deer Valley. At Sky Harbor, aircraft emissions accounted for approximately 82% of total airport-wide emissions at Sky Harbor. Third-party staff, visitor and passenger transportation comprised 16%, collectively. The Aviation Department recognizes a large majority of total carbon emissions generated airport-wide are from scope 3 emission sources that are outside of the Aviation Department’s direct control. Actions to influence and guide the reduction of scope 3 emissions through partnerships are included as part of the strategies in this Roadmap.



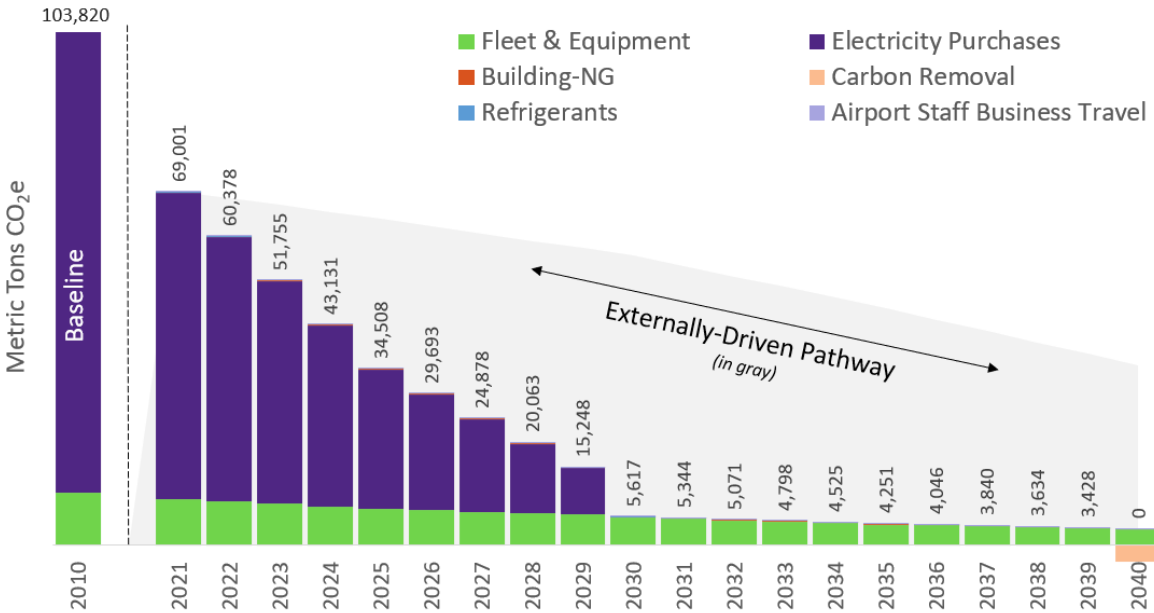
Notes: “Other” category includes deicer application; vehicles and ground support equipment; natural gas; electricity with transmission and distribution losses; construction; and off-site waste and wastewater management. Complete scope 3 emissions only calculated for Sky Harbor.

**Figure 6. Airport-wide and Aviation Department 2021 Emissions (MT CO<sub>2</sub>e)**



# NET ZERO CARBON PATHWAY

In order to reach the net zero carbon goal, the Aviation Department will need to reduce emissions as much as feasible and balance no more than 10,382 MT CO<sub>2</sub>e (i.e., 10% of 2010 baseline) with carbon removal technologies. The net zero carbon pathway illustrated in Figure 7 was developed utilizing the projections from the analytical tool described in the *Roadmapping Process*.



**Figure 7. Net Zero Carbon Pathway and Externally-driven Pathway**

The pathway maximizes near-term emissions reductions to meet short-term interim milestones. Pathway emissions decline rapidly through 2030, driven by development of projects that produce carbon-free electricity and enactment of ECMs. Emissions from vehicle fleet and equipment, buildings-NG, refrigerants and airport staff business travel gradually decline as a result of focused strategies; however, complete elimination of emissions from these sources may not be feasible. The Aviation Department plans to use carbon removal technologies or implement other future innovations to account for residual emissions.

Figure 7 also depicts, in the gray shaded area, the projected emissions if no action is taken by the Aviation Department to implement the *Net Zero Carbon Strategies*. Externally-driven pathway emissions decline by 51% in 2040 compared to 2021, driven primarily by increased renewable energy in the regional electricity grid. For example, the local electricity utility Arizona Public Service (APS) has goals to offer 65% clean electricity by 2030 and 100% by 2050. Additionally, conventional gasoline and diesel vehicles are expected to increase in efficiency over time, leading to a 15% reduction in emissions by 2040 compared to 2021.

The contribution of each net zero carbon strategy to annual emission reductions is depicted in Figure 8. ECMs are an important strategy because they reduce the electricity demand. Investment in both on-site solar and other investment in renewable energy provide the bulk of total emissions reductions (86%) between 2021 and 2040. The fleet transition additionally contributes 9%. All other strategies account for 3,333 MT CO<sub>2</sub>e, or 5%.

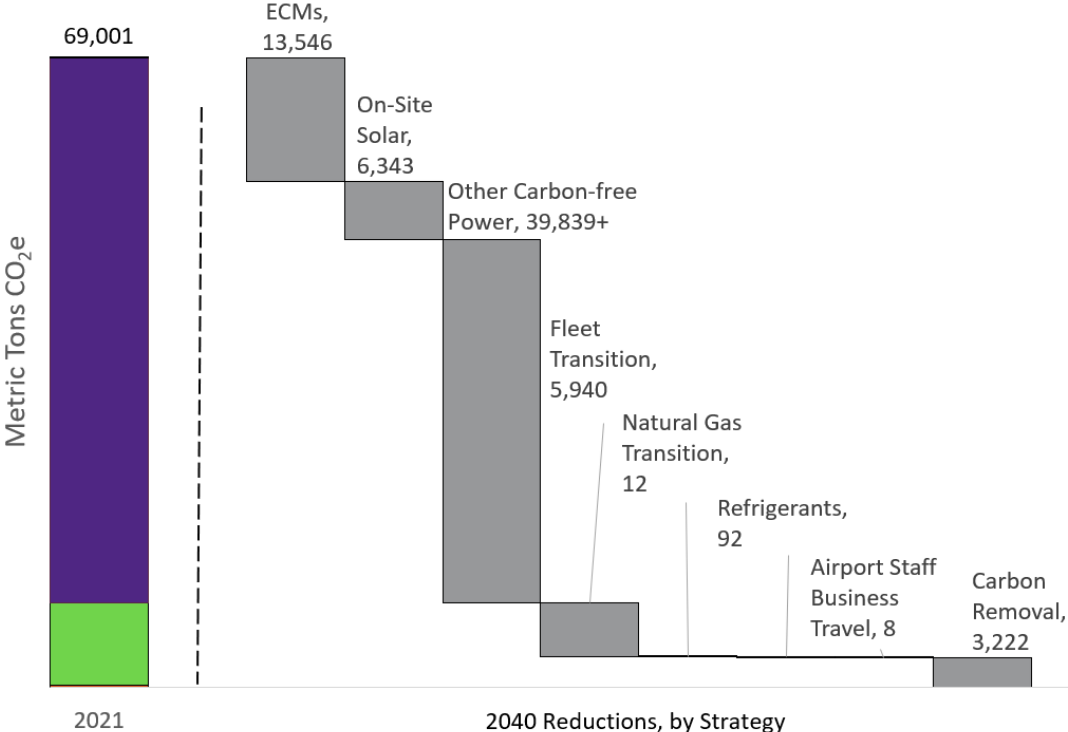


Figure 8. Emission Reduction Potential of Net Zero Carbon Strategies

### IMPORTANCE OF CUMULATIVE EMISSIONS

While carbon emissions inventories capture annual emissions, the more important factor in determining the Aviation Department’s contribution to climate change is cumulative emissions. Under the net zero pathway, cumulative Aviation Department emissions between 2021 and 2040 are 393,208 MT CO<sub>2</sub>e compared to 1,078,599 MT CO<sub>2</sub>e for the external-driven pathway—roughly 2.5 times lower.

# NET ZERO CARBON STRATEGIES

This Roadmap groups the net zero carbon strategies into three phases: short-, medium-, and long-terms, as summarized in Figure 9. **Appendix A** provides detailed information about individual projects, including a description, planned implementation year, estimated emission reduction, return on investment in years (i.e., payback) and cost estimate. **Appendix C** provides additional information on funding opportunities for these strategies.

In the **short-term (2022-2030)**, the Aviation Department will focus on implementing ECMs and developing carbon-free electricity through on-site solar projects and financing renewable energy. Together, these strategies will reduce emissions nearly 90%, while meeting the short-term interim milestones. The Aviation Department may also evaluate additional options such as a zero or low-carbon microgrid. The development of an Electricity Utility Master Plan and resiliency analysis will be integral for ensuring these strategies are implemented efficiently.

In the **medium-term (today through 2040)**, the Aviation Department will transition its fleet and buildings-NG to electric or other renewable energy, manage refrigerants, and pursue carbon removal for residual emissions. Additionally, the Aviation Department will reduce airport staff business travel emissions through promoting improved airline energy efficiency measures and other alternatives.

In the **long-term (2040 and beyond)**, the Aviation Department will focus on maintaining its net zero carbon status through continued investment in the above-mentioned strategies and ensuring that new construction is energy efficient and sustainable.

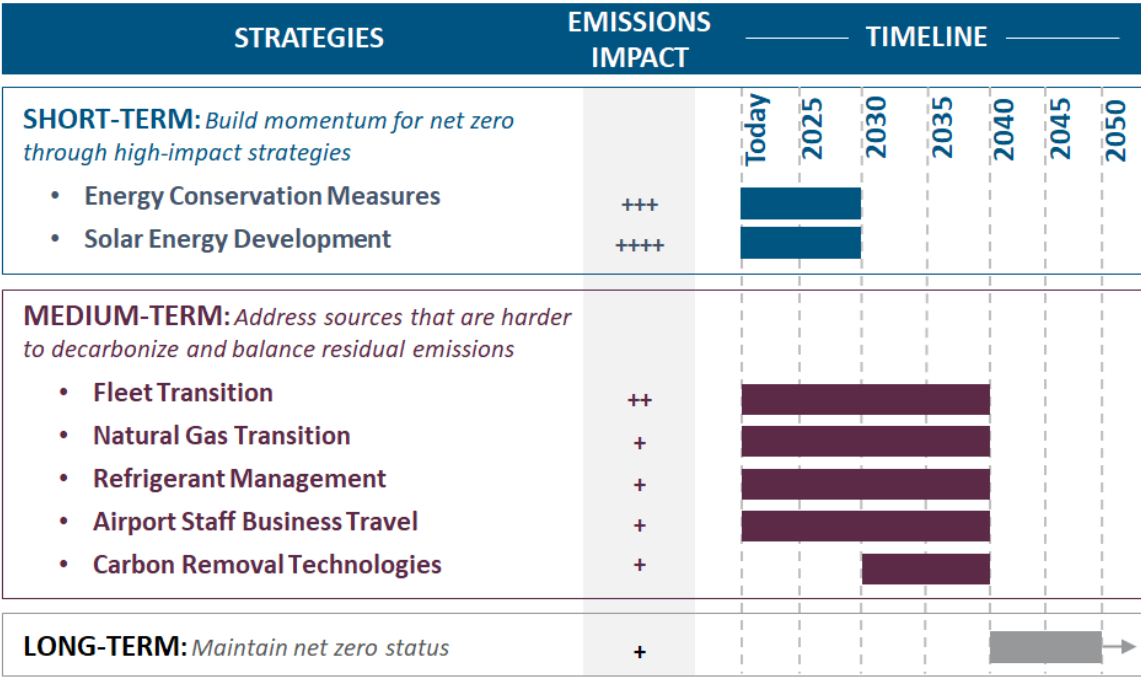


Figure 9. Net Zero Carbon Strategies

# SHORT-TERM (2022-2030)

## ECMs

<b>Carbon Reduction</b>	13,546 MT	<b>Implementation Year</b>	Fiscal Year (FY) 2023-2030
<b>Responsible Party</b>	Energy Section	<b>Implementation Actions</b>	Investment grade audits; implement actions

From 2014 to 2019, the Aviation Department reduced carbon emissions by 10% through ECMs that improved energy efficiency in existing facilities. The Aviation Department has identified over 50 additional ECMs that together would reduce emissions by another 20% by 2030, thereby meeting the interim milestone to increase efficiency of buildings. These ECMs include equipment replacement or upgrades, improvements to energy-related monitoring and controls and process changes, among others. Several ECMs have been identified that can be implemented quickly while others require further analysis of cost and carbon reduction potential through additional recommended investment grade audits.

## On-Site Solar

<b>Carbon Reduction</b>	6,343 MT	<b>Implementation Year</b>	FY 2025
<b>Responsible Party</b>	Energy Section	<b>Implementation Actions</b>	Develop and construct projects

The Aviation Department has identified eight potential on-site solar projects, with 11.8 megawatts-AC (MW-AC)<sup>1</sup> of total capacity—enough to reduce 10% of the Aviation Department’s total Scope 2 emissions. One project at the Sky Harbor Airport Command Center is budgeted, with construction to begin by September 2022. Five additional projects at Sky Harbor and one project each at Goodyear and Deer Valley airports are shovel-ready, with an implementation date of 2025. Developing these sites will decrease dependency on electricity purchases. Financial modeling indicates on-site solar is cheaper than current APS electricity purchases on a total cost of ownership basis. Next steps include completing a more detailed analysis of cost and carbon reduction potential of these opportunities and then identifying options for financing, construction, operations and maintenance. The Aviation Department has also identified opportunities for further exploration including development of an on-site zero or low-carbon microgrid and/or energy storage to supplement an on-site renewable energy system.

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<sup>1</sup> Megawatts-AC refers to the total amount of power available for consumption. Megawatt Hours-AC refers to the amount of power consumed over a period of time.



## Utility-Scale Solar

<b>Carbon Reduction</b>	>39,839 MT
<b>Responsible Party</b>	Energy Section

<b>Implementation Year</b>	FY 2030
<b>Implementation Actions</b>	Develop and construct project; APS grid interconnection study process

The Aviation Department has identified a site on department-owned property north of Luke Air Force Base for a potential third-party 80 MW-AC utility-scale solar project. Along with ECMs and on-site solar, this project would allow the Aviation Department to meet the carbon-free electricity interim milestone. Similar to on-site solar, this project would lead to production of renewable energy certificates (RECs). Furthermore, additional electricity produced beyond the Aviation Department's needs could be sold, generating further revenue. Implementing the project requires identification of service providers to secure permits, coordination of an APS electricity grid interconnection study to an APS-planned substation, and development.

## Renewable Energy Purchases

<b>Carbon Reduction</b>	As needed
<b>Responsible Party</b>	Energy Section/ Financial Management Division (FMD)

<b>Implementation Year</b>	FY 2030
<b>Implementation Actions</b>	Negotiate contract with APS; obtain approval from Arizona Corporate Commission (ACC)

Market-based approaches may be considered if aforementioned projects are not feasible or do not result in sufficient reductions to achieve carbon-free power. Through APS, the Aviation Department has the option to purchase renewable power through bundled RECs, the AG-X rate rider program with negotiated rates for several accounts, the Green Choice program or the Green Power Partners program. These options are more expensive than the standard electricity rate. Green Choice offers an immediate opportunity for carbon-free power, but it is the more expensive of the two APS programs at an additional 1 cent per kWh. Green Power Partners requires contract negotiations with APS and approval by the Arizona Corporation Commission.

## SunPower Buyback

<b>Carbon Reduction</b>	Dependent on REC value
<b>Responsible Party</b>	Energy Section/FMD

<b>Implementation Year</b>	FY 2025
<b>Implementation Actions</b>	Negotiate sale with SunPower

The Aviation Department is exploring the purchase of SunPower-owned solar energy systems at Sky Harbor's Rental Car Center and East Economy Garages. Acquiring these systems will transfer ownership of high value RECs to the Aviation Department, which could either be retained or sold to APS to fund additional renewable energy initiatives. The Aviation Department is researching this opportunity to determine the value of the revenue stream and next steps.

# MEDIUM-TERM (THROUGH 2040)

## Fleet Transition

<b>Carbon Reduction</b>	5,940 MT
<b>Responsible Party</b>	Electrical Section/Fleet Section

<b>Implementation Year</b>	FY 2023-2040
<b>Implementation Actions</b>	Implement fleet electrification plan; watch market for electric vehicle availability and cost

During the medium-term phase, the Aviation Department will prioritize a full transition of eligible airport-owned vehicles and other equipment to electric or other low or carbon-free fuel sources as the technology becomes available. The Aviation Department will install chargers or other associated infrastructure to support the fleet. The Aviation Department is developing a plan for this effort in alignment with the City Transportation Electrification Action Plan. Once implemented, vehicle electrification will reduce Aviation Department emissions by 10%. Further detail is provided in *Appendix D* including a breakdown of the current fleet and a discussion of the constraints.

## Natural Gas Transition

<b>Carbon Reduction</b>	12 MT
<b>Responsible Party</b>	Energy Section/Design and Construction Services (DCS)

<b>Implementation Year</b>	FY 2035
<b>Implementation Actions</b>	Identify replacement fuel sources and technology

Small quantities of natural gas are used in building equipment and represent less than 1% of the Aviation Department’s emissions. The Aviation Department is researching alternatives for these power sources, such as replacement of equipment with electric models or transitioning to renewable natural gas to replace conventional natural gas.

## Refrigerant Management

<b>Carbon Reduction</b>	92 MT
<b>Responsible Party</b>	Mechanical Section

<b>Implementation Year</b>	FY 2035
<b>Implementation Actions</b>	Replace older freon equipment and improve refrigerant management

Carbon emissions from refrigerants accounts for less than 1% of the Aviation Department’s total emissions, as detailed in *Appendix D*. The Aviation Department will develop a plan to improve refrigerant management practices and replace older freon-using equipment.

### Airport Staff Business Travel

<b>Carbon Reduction</b>	8 MT
<b>Responsible Party</b>	Director’s Office

<b>Implementation Year</b>	FY 2040
<b>Implementation Actions</b>	Identify cost-effective solutions

In 2021, employee staff business travel accounted for 5 MT of CO<sub>2</sub>e; however, the pre-pandemic 2019 value of 39.4 MT of CO<sub>2</sub>e was utilized as a more accurate representation. The estimate includes flights made by Aviation Department staff for official business, including air service development, and related meetings and industry conferences. While these emissions are much lower than Aviation Department Scope 1 and 2 emissions, they require a focused mitigation strategy. The Aviation Department will work with the airline industry to implement Scope 3 emissions reductions strategies to include incorporation of sustainable aviation fuels, aircraft electrification, and renewable energy sources, as identified in **Appendix B**. The department will also look to implement other strategies and innovations as they become feasible and will continue monitoring staff business travel in future carbon emission inventories.

### Carbon Removal Technologies

<b>Carbon Reduction</b>	< 10,461 MT (10% of baseline emissions)
<b>Responsible Party</b>	Energy Section/FMD

<b>Implementation Year</b>	FY 2035
<b>Implementation Actions</b>	Identify carbon credits and removal technology

The Aviation Department intends to finance carbon removal technologies or implement new innovations between 2035 and 2040 to address emissions not reduced by other measures. The net zero carbon pathway estimates 3,222 MT CO<sub>2</sub>e in residual emissions in 2040 will remain, although up to 10,382 MT may be accounted for by this strategy, according to the SBTi guidance. The expected cost of carbon removal technology is still highly uncertain. Recent studies suggest nature-based solutions, such as afforestation, are lower cost per metric ton than engineered solutions like direct carbon capture. During the medium-term phase, the Aviation Department will prioritize the identification of appropriate and cost-effective solutions.

# LONG-TERM (2040-ONWARDS)

## Additional ECMs, Renewable Energy, Net Zero Carbon Building Standards, and Carbon Removal

<b>Carbon Reduction</b>	Not Assessed	<b>Implementation Year</b>	FY 2040 - on
<b>Responsible Party</b>	Sustainability Section/DCS	<b>Implementation Actions</b>	Identify cost-effective solutions; implement net zero carbon construction standards

Once the Aviation Department achieves the net zero carbon goal, it will maintain this status. The Aviation Department will continue implementing additional ECMs, renewable energy development, and carbon removal technologies to negate future emissions associated with airport growth. The specific measures will be assessed each year. The Aviation Department will also require that all new construction prioritize energy-efficient equipment, technologies, and related innovations, and incorporate solar where feasible. This last strategy is guided by the interim milestone of designing and constructing facilities to the Living Building Challenge, an international sustainable building certification program to promote energy-efficient buildings (<https://living-future.org/lbc/>) or equivalent design standard by 2050.



# MONITORING

This section describes steps to monitor and update the Roadmap. Examples of scenarios that may require a change to the actions include new local, state, or federal regulatory requirements regarding carbon emissions, fundamental changes to funding mechanisms, or significant technological developments (for example, significant cost reductions in electric vehicles). If a future change is required, the Aviation Department may want to report the new goal(s) or metrics with a description of the circumstances that justified the change(s).

The Aviation Department commits to the following monitoring activities:

- **Updates to Roadmap.** At least every three years, the Aviation Department will update this Roadmap and the underlying carbon emission estimates.
- **Periodic carbon emission inventories.** The Aviation Department commits to conducting a carbon emission inventory at least every three years or more frequently as required by the ACA program participation.
- **Review of progress towards goals.** In conjunction with the periodic carbon emission inventory, the Aviation Department will conduct a review of progress towards its 2040 goal. Specifically, the department will compare emission projections to actual measured emissions to understand if the rate of emission reductions aligns with the net zero pathway.
- **City's climate action planning.** The Aviation Department will actively participate in the City's Climate Action Plan implementation and future planning efforts. Additionally, the Aviation Department will contribute information for the City's carbon emission inventories.



Note: Appendices omitted in external version.