Transitioning to a Sustainable Energy Mix at Airports

Expanding options, reducing emissions and adding value as an energy hub

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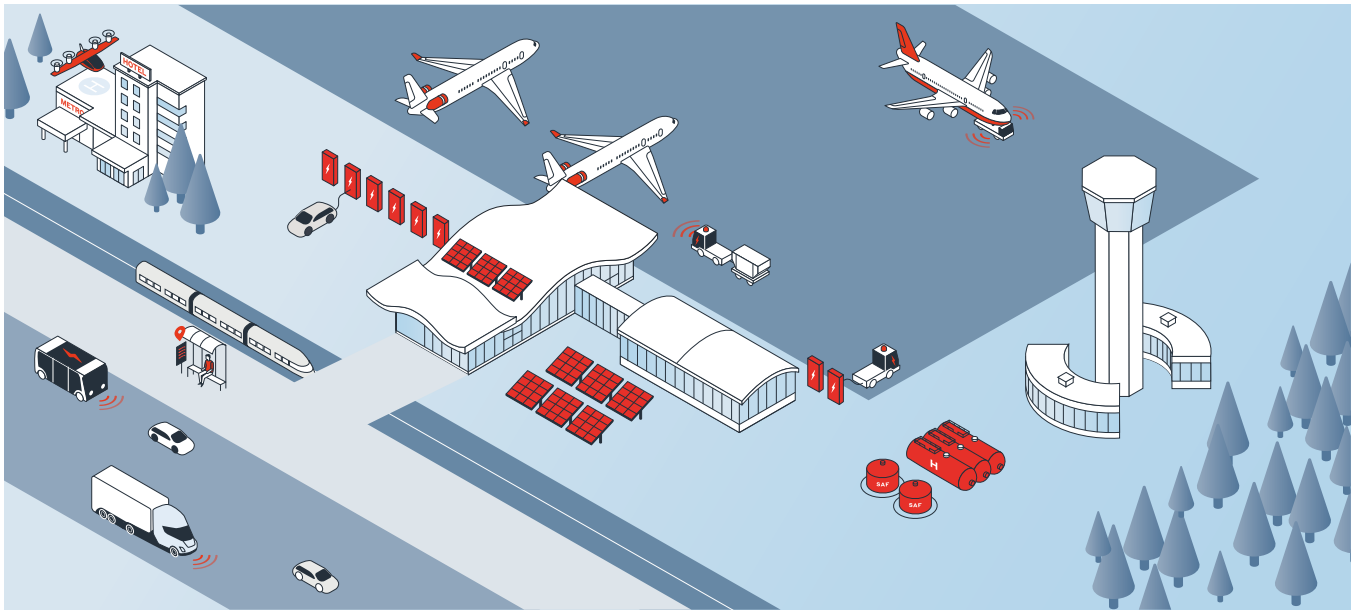

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In the following Q&A, WSP energy experts discuss options that can support the energy needs of airports as they transition from fossil fuels to a sustainable energy mix, one that prioritizes decarbonization and minimizes impact on the environment. As part of this Future Ready®[1] perspective, they also discuss how to develop a more self-reliant energy system.

1 Future Ready® is WSP's global innovation program, which seeks to better understand the key trends in climate change, society, technology, and resources and how they are impacting our world, locally and globally. The goal is to work with clients to design for future needs as well as those of today. Future Ready® is a registered trademark of WSP Global Inc. in Canada and New Zealand. WSP Future Ready (logo)® is a registered trademark of WSP Global Inc. in Europe, Australia and in the United Kingdom.

Can you summarize the key steps for airports as they transition from fossil fuels to a sustainable energy mix?

Sagar Kancharla: Airports have high energy demands because of the multiple systems involved to maintain 24/7 operation. A fundamental step is to explore and identify how to reduce demand through energy efficiency and conservation programs then look at all the options available that can comprise a sustainable energy mix. It is essential to understand the sources of emissions and identify the suitable substitute low-carbon technology or fuel for a particular application. This involves analyzing at a granular level all the applications and will result in a comprehensive list of alternative energy options for each energy application. The sources of emissions primarily come from the use of high-carbon fuels or technologies for heating, cooling or mobility.

Anthony Ciccone: Implementing a sustainable energy mix requires long-term investment and an integrated energy policy. They represent significant steps toward reducing airports' carbon footprints and achieving net zero.

An integrated energy policy to achieve net-zero emissions requires a combination of strategies that focus on reducing greenhouse gas emissions, increasing the use of clean and renewable energy sources, and managing water more efficiently. These objectives involve improving energy efficiency, giving preference to carbon-zero energy sources and neutralizing difficult sources of carbon, through, for example, carbon capture and storage. In addition, water efficiency measures should adhere to circular economy principles, where water use is reduced through recycling and reuse, thus decreasing strain on water resources.

What are some applications for alternative energy options?

Steve Kiser: The options available for carbon-emissions reductions are numerous, each presenting specific pros and cons that might provide more value for certain applications than others.

Taking a holistic perspective, we can review the options across a full energy lifecycle—an energy "Make It, Move It, Use It" model. Typically, as Sagar noted, a first step that can provide meaningful emissions reductions starts with energy efficiency and reduction of energy usage–the "Use It" part of an energy lifecycle; although placed last in the model, in reality this end-step is also the first step, reflecting an iterative approach that continuously connects use with actual need. Reducing use and improving efficiency can be accomplished by steps as simple as updating lighting, adjustments to HVAC (heating, ventilation and air conditioning) systems, replacing existing HVAC systems with heat pumps where possible, and more efficient building envelopes, among other steps.

For the "Make It" or generation part of the equation, utilizing solar power can be a cost-effective option, and when paired with some form of energy storage via batteries, for example, solar power is a relatively easy and low-carbon option. Natural gas is a great bridge fuel for airport operations, and, while not a zero-emissions option, it does provide the reliable baseload energy that is required for airport operations. Another option that is gaining acceptance for clean energy generation is the use of nuclear—specifically small modular reactors (SMRs)[2] and other advanced reactors. These can be costly and take longer to implement than other options, but they do provide long-term, stable, zero-emissions options that other technologies currently can't match.

Lastly, the "Move It" portion of the lifecycle involves how electricity gets from its generation source to the end-user, and stored for when it is needed as well. Reliability projects for transmission and distribution networks are increasingly more common when buying power from the grid, usually from a local utility provider. However, we have been seeing a dramatic increase in distributed generation projects globally, essentially moving the energy generation—"Make It"—much closer to the end-use location, typically on the same site where it is needed.[3] This usually comes with a high initial capital cost to create the generation source, but has benefits including lower long-term energy costs, more reliability and control of energy, and lower emissions when utilizing renewable energy sources.

2 What are Small Modular Reactors (SMRs)? International Atomic Energy Agency (IAEA), September 13, 2023.

3 Unlocking the Potential of Distributed Energy Sources, IEA, Paris, May 2022.

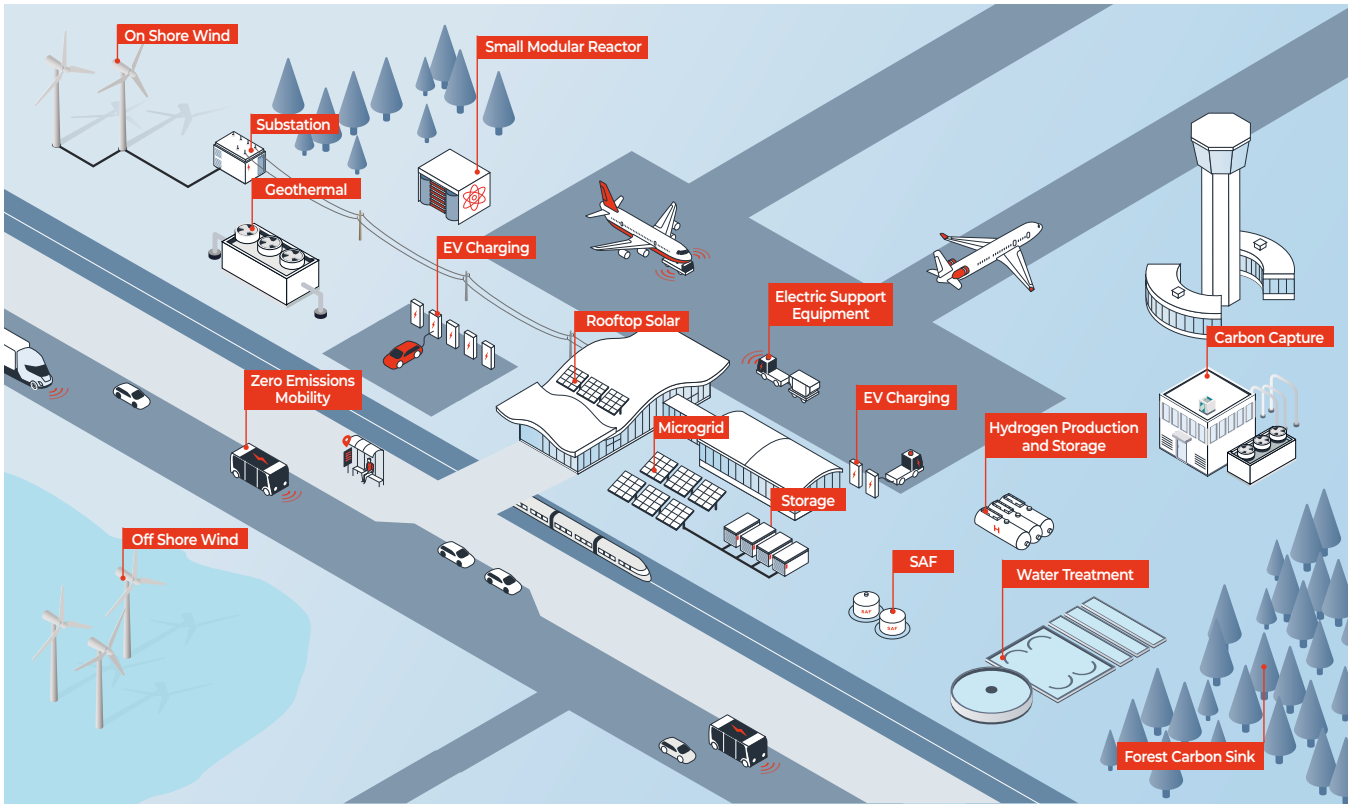

Figure 1 - Options for a sustainable energy mix at airports, considered through WSP's Future Ready® lens

How can airports make the best decisions to put these options to work?

Anthony Ciccone: There are several broad considerations when making the best decisions to apply clean energy and renewable options. In designing new facilities or upgrading existing assets, sustainability needs to be integrated into the decision-making process from the start of a project, committing to more sustainable practices from the outset. Starting early in the planning and design stages opens up opportunities and enables key stakeholders to play a role in decisions impacting a range of activities shaping the operation of the airport.

Steve Kiser: That early start is really important because, like so many evaluations, finding the right solution that works for a particular airport operation requires balancing multiple priorities established upfront. Generally, the considerations might include some combination of carbon-emissions reductions goals, the timing of emissions-reduction commitments, cost, reliability, resilience and security, and availability of appropriate technology. For example, solar plus battery storage might meet cost, timing and emissions target goals but isn't always the right option for supporting mission-critical 24/7 operations since airports can't have power disruptions.

Anthony Ciccone: Another consideration is whether or not SMR technology can be incorporated into the energy mix to produce on-site carbon-free electricity, which can decarbonize the landside activities. In addition, since achieving economy-wide net-zero carbon emissions by 2050 requires decarbonization across both landside and airside activities, all airports will need to convert their ground fleets to electric vehicles.

Steve Kiser: The increase in popularity of fleet electrification, distributed generation (DG) solutions and microgrids[4] can accelerate needed progress toward emissions reductions, and the latter two can strengthen energy security and reliability; but having available space and infrastructure to support the DG and electrification build-out can be a challenge. Natural gas options satisfy most of these considerations, with the notable exception of not being a zero-emissions technology. Hydrogen is a very popular zero-emissions fuel that has numerous applications for fleet decarbonization, power generation and industrial processes, but cost and safety still have some room for improvement and innovation. So again, decision-making is a balance of priorities.

4 Microgrid definition from National Renewable Energy Laboratory: A microgrid is a group of interconnected loads and distributed energy resources that acts as a single controllable entity with respect to the grid. It can connect and disconnect from the grid to operate in grid-connected or island mode.

Sagar Kancharla: In addition to establishing priorities and addressing them, the right framework will apply varied metrics to make the best decisions. Investment decisions entirely based on financial metrics will not make sustainable solutions feasible in most cases. The criteria could include technical, financial, economic and ESG factors. Each of these factors would have multiple subfactors. For example, under the technical criteria, one could have subcriteria, such as technology maturity, technical feasibility, accessibility and reliability.

As a rule, any decarbonization solution will consider the operational sources of emissions. It will also explore ways to reduce fuel-based emissions; during the transition to widespread use of low-carbon fuel, reductions in emissions can be achieved through the better use of space. For example, airports can influence how passengers, cargo and employees arrive and leave the airport and how planes are circulating just before landing or taxiing in the airport.

Can operations like de-icing be completed with less emissions from moving planes around? Can electric or hydrogen or renewable natural gas vehicles be used for taxiing purposes? These are a couple of the questions airports need to address today as they determine how to modify practices and apply the best clean energy options over the long-term—to achieve net zero and continue on the course of decarbonization.

Airports' core decarbonization efforts can be strengthened by exploring incentive programs that reward emissions reduction. Such programs include government grants as well as investment tax credits for clean energy investments.

In addition to helping airports make meaningful progress toward greenhouse gas reduction objectives, what other benefits can the use of alternative energy options provide?

Steve Kiser: Energy security and reliability is an increasingly important part of integrated solutions, as physical and cyber threats and natural disasters can be major stresses on an energy system. By moving toward a more locally produced and consumed electricity source like distributed generation solutions—solar plus storage, for example—airports can take advantage of built-in physical and cybersecurity infrastructure and have less reliance on energy systems outside of their control. This shift toward self-reliance positions airports to have access to a more reliable and resilient energy system.

When making decisions for today's needs with an eye toward the future, an advanced technology like SMR is an attractive means to provide a much longer lifespan of stable, reliable energy than renewable energy sources such as solar combined with battery use for storage. These renewable technologies have a typical life span of 15-20 years, which means disposing of assets much more frequently than for a generation source like nuclear. This approach can then require significant capital investment for redevelopment of renewable power generation compared to a potential 60-80 year lifespan of SMRs. This point emphasizes the need for diversification of energy technologies to achieve both decarbonization goals and energy reliability.

Additionally, when fostering a clean energy environment, there are intangible benefits for passengers and employees such as strengthening a sense of community pride. In fact, many stakeholders, including the public and airport staff, need to be included in the engagement process when developing airport projects as they provide essential support for project implementation and success. Benchmarking and accreditation could help in this process. As an example, since 2009, the airport industry has increasingly embraced the global Airport Carbon Accreditation (ACA) program, which provides a certification framework for airport carbon emissions management and reduction.[5]

Anthony Ciccone: As we discuss the added benefits of clean and renewable energy options, a natural link and consideration is the reduction of water usage.

Airports can dramatically improve both energy and water efficiency—through water reuse. Water usage is a highly energy-intensive process. Steps to manage and improve equipment systems and water use can reflect in both energy efficiency and water usage. Application of new high-efficient technologies such as smart pumps, leak-detection sensors and other digital solutions can reduce energy needs for the treatment and transport of water. Renewables—solar and wind—require very little water use compared with water-intensive fossil fuels, which require water for cooling and wastewater treatment.

5 This voluntary initiative was co-developed by Airports Council International (ACI) Europe and WSP and has become the international global standard for managing airport carbon emissions to support a climate-smart future. The ACA program has been administered by WSP since its launch in 2009.

How might the shift to clean energy and renewable energy options impact existing space as well as infrastructure needs to support distributed generation and electrification build-out?

Sagar Kancharla: Airports need to take a look at how space is already being used and how existing space could be utilized to support the energy transition. As they transform into integrated passenger and cargo transportation hubs, extending connectivity for passengers via rail, road and sea, airports will need to balance transport needs with space for energy needs.

With the transition to electric vehicles, from ground support equipment to ground access transport, and the increase in electric vehicles for both personal use and rental cars, airports should consider if space currently assigned for parking can be reallocated to support EV charging stations and other clean energy infrastructure. Consideration should also be given to the space needed for managing the movement of ridesharing vehicles, especially as this mode of travel is expected to increase globally, and the emergence of advanced air mobility services.

Other factors include how and where solar panels can be situated and the placement of carbon capture units. As renewable options are evaluated, is there opportunity to extend efforts to forestation in and around airports as these green initiatives can act as carbon sinks, removing CO_2 from the atmosphere?

Anthony Ciccone: These and other factors need to be considered from the holistic perspective that Steve discussed earlier. For airports that have limited space restrictions, having a compact power generation system is advantageous. Here is where SMRs can come into the picture as they generate a significant amount of power/electricity in a relatively small space as compared to solar or other renewable sources.

Steve Kiser: As airports take a look at their needs and what is possible to implement, one consideration is to become an energy hub. By integrating viable technologies such as solar and other renewable energy sources, airports can significantly reduce their carbon footprint and become self-sustaining facilities that generate, distribute, use and store renewable energy. This may not require much more space than what airports currently occupy, depending on technology options selected.

Surplus energy generated during non-peak hours can be stored in battery energy systems, providing a stable power supply during peak hours or emergencies.

Anthony Ciccone: In addition, the excess energy can be sold on the grid as a source of revenue for the facility and thereby also support wider decarbonization.

Can you elaborate on how the energy hub concept can add value for airports?

Sagar Kancharla: Beyond lowering their own carbon print by switching from conventional energy use, there are three notable opportunities for airports as energy hubs. First, airports are surrounded by distribution centres enabling everyday global commerce. These airport energy hubs can now act as energy distribution facilities, supplying clean energy to adjacent businesses and neighboring communities.

As the aviation sector transitions to sustainable low- and zero-carbon fuels, airports will have facilities producing or storing sustainable aviation fuel [SAF]. It is possible that these energy hubs will have the economies of scale to explore more technological options that serve aviation fuels, airport energy needs and neighboring energy demands—for example, as a green hydrogen hub with the entire energy value chain.

Airports have grown quite big in the last decade and have become mini cities with increased activities. There are shopping outlets, recreational facilities, resting places and business centers, along with the core activities of transporting people and cargo. With increased movement of people and goods at the airport, comes increased demand for energy. Whether for warming of food at the food-court or moving baggage from check-in counters to the airplanes, the energy needs can be met by using the energy hub's clean and renewable alternative resources, resulting in reduced emissions on the ground as well as in the air through localized SAF production, thus progressing decarbonization efforts in aviation and in society at large.

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