The United Nations estimates that the global aviation industry accounts for roughly 2% of global carbon dioxide emissions. Most of this impact is from jet fuel emissions, but terminals and their operations are a measurable part of the picture.

The Federal Aviation Administration and the International Air Transport Association have set out ambitious sustainability goals that airports around the world have signed on to support, through efforts such as the Airport Carbon Accreditation program. These goals range from reducing greenhouse gas emissions and using electric vehicles to developing sustainable aviation fuels and ef f cient aviation infrastructure — including terminal buildings. Carbon neutrality focuses on limiting carbon dioxide equivalent emissions and offsetting the emissions produced to achieve "neutrality" whereas net zero encompasses reducing all carbon dioxide equivalent emissions to as low as feasibly possible prior to onsite or offsite offsets; both must be addressed for airports to achieve sustainability goals.

Airports aiming for net zero will require both proven solutions and ideas from other building sectors. Facilities whose building envelope and systems use sustainable design approaches will begin with principles that are applicable to any building: using the local climate for passive heating/cooling, reducing internal zone loads via analysis-driven façade selection, and optimizing mechanical, electrical, and plumbing systems' ef f ciencies and control sequences. Then when applied to an airport terminal, an integrated approach takes advantage of features such as terminals' large volume spaces, sprawling sites, and traveling and working occupants.

Net Zero Terminal Lessons: Proven and Innovative Solutions

A forward-thinking approach to terminal design is most effective when we draw on best practices both from airport terminals and other building types that:

» Optimize form and function to deliver aesthetic results with minimal impact

»

1. Optimizing Form and Function

manufacturers are found throughout the United States, which is important because "embodied carbon" considers the travel distance between the source, the manufacturer, and the project site.

Often the biggest carbon expenditure in structures is **concrete**. The process for manufacturing cement, the all-important glue that binds concrete, accounts for roughly 8% of the world's anthropogenics buildings, including airport terminals, can be designed to use solar power via DC to drive LED fixtures, resulting in more efficiency, overall lower system costs, less infrastructure, and less maintenance.

Eliminate

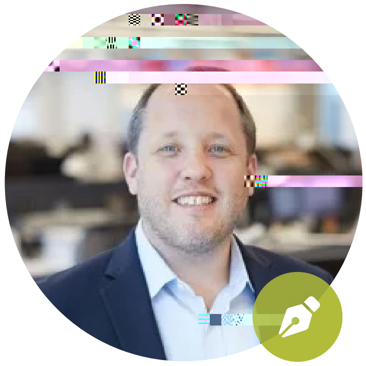
Finally, the third tipping point "eliminates" all fossil fuel combustion. Buildings that are designed to be all-electric eliminate onsite air quality issues associated with fossil fuels, such as harmful byproducts and PM2.5 particulates, and efficiently use on-site generated electricity from renewable energy systems. Renewable energy can be directly used year-round with the incorporation of on-site building energy storage system.

Backup and standby power systems, historically powered by diesel generators, can instead be powered by renewable energy sources because of recent changes to National Fire Protection Association code. Building energy storage systems and fuel cells can be used as backup/standby power when such systems meet startup/changeover time thresholds.

An all-electric building without offsetting renewables is not yet zero emission today, because the U.S. power grid is still heavily dependent on fossil fuels, but as the grid decarbonizes, all-electric buildings can become net zero.

Heat pumps and geo-exchange systems are key technologies to consider when eliminating fossil fuels. **Heat pumps'** advantage is that they are an efficient means of generating heat via an all-electric source. In the cooling season, heat is removed from a space and transferred to the atmosphere, ground, or water-source, whereas in the heating season, heat is extracted from the atmosphere, ground, or water-source and delivered to the occupied space. Air source pumps, which use the atmosphere as a heat source/sink, have the most flexibility and adaptability, but are less effective at outside air temperatures below 40 degrees Fahrenheit. Heat pumps using ground or water heat source/sinks provide additional operating range during lower outside air temperatures.

Geoexchange or geothermal systems are increasingly embraced by airports; Vancouver and Louisville are both incorporating geothermal systems that use the relatively constant temperatures of the below-grade earth as a heat source/sink in combination with heat pumps to generate heating and cooling. Typically configured geoexchange vertical

About the Author

Josh Greenfield, PE, is the high performance design director at HDR, Inc. With more than 15 years of experience in energy consulting and sustainable design, Josh is spearheading the firm's 100% energy modeling initiative. Josh worked on one of the largest LEED Platinum-certified projects in Mexico City, designed the first solar ventilation wall system in the city of Chicago, and presented on numerous sustainability and energy topics at various conferences.

Kevin Ashton, AIA, is the aviation architecture principal at HDR, Inc. Kevin focuses on airport design and project development, from conception and planning to construction and completion. He draws on more than 25 years of aviation architecture experience related to the planning, design and construction of signature and award-winning airport terminal designs both in the U.S. and abroad.

About the Article

Republished from HDR's Experts Talk. Experts Talk is an interview series with technical leaders from across HDR's transportation program. HDR specializes in engineering, architecture, environmental and construction services.
While the company is most well-known for adding beauty and structure to communities through high-performance buildings and smart infrastructure, they provide much more than that. HDR creates an unshakable foundation for progress because multidisciplinary teams also include scientists, economists, builders, analysts, and artists. HDR employees work in more than 200 locations around the world.