



Frontiers

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Powering our future

ecoDemonstrator program
charts flight path for innovation

NO STEP

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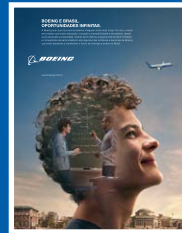
This ad highlights the all-electric Boeing 702SP (small platform) satellite and the advantages this innovative technology brings to Boeing's satellite customers. The ad appears in trade publications.

12-13



Build a Better Planet is the theme of a series of posters highlighting Boeing's commitment to responsible environmental leadership. This ad features Boeing's restoration work along the Duwamish Waterway in Seattle.

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Part of the "Boeing & Brazil. Endless Opportunities" campaign, this ad focuses on Boeing's role in education. Translated, the text reads: Boeing wants to take young Brazilians even further and invests in projects that take education to students of all ages. Ayrton Senna Institute, Science without Borders Program and SAE Brasil AeroDesign are some of the partnerships that are changing the future of children and young Brazilians.

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FSC LOGO



AN ELECTRIC LEAP FORWARD.

The Boeing 702SP satellite is the first and only all-electric satellite, a game-changing technological leap. The all-electric propulsion system dramatically reduces spacecraft weight, creating more affordable launch options as well as the opportunity to add additional payload in the 3-8kW range. Two 702SP satellites can even be stacked on a single launch to reduce costs further. Now, that's the power of innovation.



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Boeing launched its ecoDemonstrator program in 2011 to accelerate the testing and refinement of new technologies to improve aviation's environmental performance. This year, the program is using a 787 as its flying laboratory to evaluate more than two dozen technologies, from software that will provide pilots with improved weather and route information to hardware designed to lower weight, save fuel and reduce airplane noise. The program allows new technologies to be tested as soon as they are ready, speeding implementation on commercial jetliners.



COVER: The 2014 ecoDemonstrator is a 787-8. From left, Boeing Research & Technology employees Bill Keith, T Pinney, Leanne Lehman and Craig Frankel. **BOB FERGUSON/BOEING**

PHOTO: The 787 ecoDemonstrator airplane makes a low-level pass over an acoustical array of microphones that measure aircraft noise during flight tests at Moses Lake in Eastern Washington. **JIM ANDERSON/BOEING**





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Designed to be a Mach 3 bomber, the XB-70 Valkyrie instead played another role—researching the challenges of a supersonic commercial transport.

PHOTO: BOEING ARCHIVES



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Two small Boeing sites only a few miles apart in Pennsylvania have big roles in manufacturing and testing critical equipment for warfighters.

PHOTO: BOB FERGUSON/BOEING



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Working with airline customers, Boeing designed a 737 storage bin for passenger carry-on bags that is so large it is dubbed the “Space Bin.”

PHOTO: BOB FERGUSON/BOEING



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PHOTO: MATTHEW THOMPSON/BOEING

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See center of magazine for special pullout poster.

SNAPSHOT

Leadership in lift

MV-22 Ospreys from U.S. Marine Helicopter Squadron One stand ready following the arrival of a VC-25, the 747 known as Air Force One when transporting the president of the United States, shown in the background. The Bell Boeing MV-22 recently replaced the CH-46 Sea Knight for the elite mission of transporting White House staff, Secret Service members and the press corps. With its tilt-rotor design, the MV-22 can land and take off like a helicopter but fly with the speed and performance of a fixed-wing airplane.

PHOTO: JOHN MORGENSTERN





QUOTABLES

“Last year the 787 had the highest customer satisfaction scores, on average more than 15 points higher, than the rest of our fleet.”

—United Airlines, about its 787 Dreamliners.
Aviation Week & Space Technology, July 14

“The right people were listening to the right people at the right time.”

—Lt. Gen. Thomas W. Travis, U.S. Air Force surgeon general, about Boeing’s C-17 Globemaster III airlifter and how its designers came up with a “lifesaving” aircraft with a cargo hold that can quickly be reconfigured to transport wounded warfighters at a high level of care en route to a hospital.
Aviation Week & Space Technology, July 28



Charles Bailey

HAS WORKED FOR BOEING:
11 years

ORGANIZATION:
Boeing Training
Systems &
Government
Services

HAS BEEN PART OF THE TEAM:
10 years

Simulation fascination

For this Boeing engineer, the C-17 program provides real—and virtual—opportunities

As told to Ashley Johnson, with photo by Rich Rau

Charles Bailey is a C-17 test engineer in Boeing Training Systems & Government Services, part of Defense, Space & Security. In this *Frontiers* series that profiles employees discussing their jobs, Bailey talks about the importance of working closely with C-17 customers—and his lifelong passion for aviation.

I was hooked on flying the first time my father handed me the controls. He was an aviation business owner and aircraft salesman who had been a test pilot and captain with the Royal Canadian Air Force. I was 7 years old, and the thrill of having the controls and thinking I was actually flying a twin-engine airplane set the course for my career.

I worked as an airline pilot for 34 years, 11 of which were spent flying and instructing on the 767. I also had the opportunity to fly the 707, 727 and 757, and accept new airplanes for my airline at Boeing Field in Seattle, where I was impressed by Boeing's emphasis on quality control.

When I retired I wanted a new challenge, so I sought out an engineering director at Boeing for an informational interview. Eventually I was hired as test director of the KC-767 tanker program (the predecessor to today's KC-46A tanker), and then I moved to the C-17 Globemaster III test engineering program, where my job is to ensure that the C-17 simulators and other training devices work just like the real aircraft.

Working with simulators is natural for me. At age 12, I built my first simulator using an old single-engine

fuselage, wings made of wood and an Indiana cornfield as my runway. I powered a homemade beacon and landing lights with 110-volt electricity from a detached garage—and blew many fuses in the process.

Joining the C-17 program was like going to school on a new type of aircraft. The main difference between commercial jetliners and military aircraft is the mission. The mission for commercial airliners is to fly from point A to point B in all types of weather and stay on schedule; the mission for the C-17 is to transport troops and cargo. Offloading cargo in a combat zone is complicated and requires a lot of training. Military pilots are trained in formation flying and assault landings on short runways, and the C-17 simulator has visual models to replicate these maneuvers.

My co-workers and I write test procedures, meet with customers, and show them how the hardware and software works. Having a good rapport with the customer and establishing trust is crucial. Meeting the requirements and needs of the U.S. Air Force and other customers isn't easy. But in June, we made back-to-back deliveries in Memphis, Tenn., and the United Arab Emirates—

that's two C-17 Training Centers delivered on schedule, one day apart, to locations half a world apart.

Another part of my job is guiding tours of the simulator and demonstrating the C-17's unmatched capabilities. At 400,000 pounds (181,400 kilograms) gross weight, the C-17 can land on a 90-foot-wide (27-meter-wide) gravel runway and stop in as little as 2,100 feet (640 meters)—what other aircraft its size can do that? I've given tours to everyone from members of Boeing's board of directors and members of the U.S. Congress to foreign dignitaries, documentary crews and a child with cancer whose wish was to "fly" in a simulator.

I've spent almost 11 years at Boeing, each of which has been exciting because every workday brings new challenges that I get to solve. It seems my whole life has been flying and engineering—and I wouldn't have it any other way. ■

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HISTORICAL PERSPECTIVE



Speed surfer

The XB-70 Valkyrie was designed to be a Mach 3 strategic bomber, but it ended up in a much different role

By Mike Lombardi

Fifty years ago, on Sept. 21, 1964, about 5,000 employees of North American Aviation and guests gathered at U.S. Air Force Plant 2 in Palmdale, Calif., to watch a six-engine, experimental military aircraft take off for the first time.

It was unlike anything that had flown before—graceful, awe-inspiring and designed to surf its own shock wave.

The XB-70 Valkyrie was the embodiment of innovation and a testament to the talent nurtured under the leadership of North American founder Dutch Kindelberger, company president Lee Atwood and chief engineer Harrison Storms.

That successful first flight of the XB-70 represented an effort that began

in 1954 when both Boeing and North American submitted designs for the Air Force Weapon System 110A competition. In December 1957, North American was named the winner. (North American is one of Boeing's heritage companies.)

The XB-70 was the prototype for a nuclear-armed bomber for the U.S. Air Force's Strategic Air Command. It would fly three times the speed of sound at more than 70,000 feet (21,000 meters). At that altitude it would be able to evade interceptor aircraft.

Even before the XB-70 was off the drawing board, however, advances in Soviet air defenses resulted in an emphasis on less-expensive intercontinental ballistic missiles as the

mainstay of the U.S. nuclear forces. In April 1961, the Air Force cut back the B-70 to a research program. The second Valkyrie, XB-70A-2, flew in July 1965.

As a research program, the XB-70s introduced many new technologies including a revolutionary design that relied on an aerodynamic theory called Compression Lift, which gave the Valkyrie additional lift from its own supersonic shock wave. At supersonic speeds, the outer wing panels hinged downward up to 65 degrees to improve directional stability.

Just behind the cockpit were two large control surfaces, known as canards.

North American came up with a steel honeycomb sandwich skin that could withstand the high temperatures



of hypersonic flight. It was manufactured using a brazing process, a technique that became widely used throughout the aerospace industry, rather than being welded.

Interest in a commercial supersonic transport, or SST, was growing and the XB-70 was similar in size and had the speed of some SST engineering concepts.

But the first prototype achieved only Mach 3 on one flight. Improvements were made to the second Valkyrie, which resulted in much better handling. It made a number of Mach 3 flights. NASA and the Air Force signed an agreement to use the second XB-70 for high-speed research flights for the SST program, beginning in mid-June 1966. But on June 8 tragedy struck during a photo flight with the

second XB-70. Several chase planes had just finished filming the Valkyrie when one of them, an F-104 flown by NASA pilot Joe Walker, who had been named project pilot for the SST research, drifted into the Valkyrie's wingtip and was captured by its wake vortex. The small fighter then clipped off the XB-70's vertical fins, resulting in the loss of both aircraft, along with Walker and XB-70 co-pilot Carl Cross; Al White, who was piloting the XB-70, ejected and survived the accident.

The surviving Valkyrie, XB-70A-1, continued to fly for NASA, testing the flight regime of a supersonic transport. The aircraft made its final flight in February 1969—from Edwards Air Force Base in California to Wright-Patterson AFB

in Ohio, where it was put on display at the National Museum of the U.S. Air Force.

With a maximum takeoff weight of 542,000 pounds (246,000 kilograms), the XB-70 remains the largest and heaviest airplane ever to fly at Mach 3. Its size, speed and design, even 50 years after that first flight, still serve as an inspiration—and perhaps an influence—for engineers who continue to tackle the many challenges to efficient and affordable supersonic commercial air travel. ■

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PHOTO: The XB-70A-1 retained its U.S. Air Force markings after NASA took over the flight-test program. **BOEING ARCHIVES**



Build a Better Planet

Remember Restore Rediscover

boeing.com/duwamish



CARRY ON, 737 PASSENGERS





Boeing teams work with airline customers to develop new 'Space Bins' for the 737

By Dina Weiss and photo by Bob Ferguson

Brent Walton was about to board a flight from Seattle to Orlando, Fla., when he was told he'd have to check his carry-on bag at the gate.

"There's nothing more frustrating than being one of the last to get on the plane and being told you have to check your bag, because all of the bins are full," said Walton, a manager of new features for 737 interiors in Renton, Wash.

Walton knew there was a solution in sight, however, because he and his team were developing it. With input from Alaska Airlines, they were moving quickly to design an innovative stowage bin so large it was dubbed the Space Bin.

"We recognized a shift in the market, with growing interest in a larger bin option, both in production as well as retrofit," Walton said.

To develop the Space Bins, Commercial Airplanes invited flight attendants, customer service agents and others to visit Boeing's design center, test prototypes and provide feedback to the Boeing team. That team included 737 design engineers, Commercial Aviation Services modifications representatives, product marketing and new features experts, as well as engineers from the Interiors Responsibility Center and the Payload Innovation Center.

"The collaboration across the teams has been impressive," said Jeri Imhof, project manager for the 737 Interiors New Features team.

Mark Eliassen, Alaska Airlines treasurer and vice president of finance, said he told Boeing sales executives, "If you build it, we'll buy it and we're confident other airlines will, too. That's how committed we were to working with Boeing to create additional storage space for our passengers."

While other airlines have not yet signed up for the bins, they have expressed strong interest, and

their requirements helped shape the design, Walton said.

On a 737-900ER (Extended Range), the new bins will allow overhead compartments to accommodate 194 bags, compared with the current 132 bags. When the Space Bins are open, the bottom edge hangs about 2 inches (5 centimeters) lower than today's bin, which not only makes it easier for passengers to load bags but should speed up boarding, Matthew Coder, manager of in-flight experience at Alaska Airlines, pointed out.

Throughout design development, the team was able to increase bin space while also maintaining the open look and feel of the cabin, Imhof said. Adding to the customers' list of must-haves was the requirement for a single design that would work for both newly produced 737s and for 737s already in service as a retrofit.

Design workshops and an on-site mock-up have helped to keep the Space Bins project on track.

"Being able to quickly try out our designs was great," said Asim Chadha, lead design engineer for stow bins at the Interiors Responsibility Center.

"Loading the bins with extra bags and testing how easy they were to close—the mock-up made it all real and we could see that they work," Chadha said.

Passengers will get to experience the real thing when Space Bins are introduced on new Alaska 737s next year. ■

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PHOTO: Checking out the new Space Bins are Asim Chadha (foreground, from left), lead engineer, Interiors Responsibility Center, and Brent Walton, manager, 737 Interiors New Features, along with Derek Minyard (background, from left), Stowbin lead engineer, and Jeri Imhof, project manager, 737 Interiors New Features.



ecoDemonstrator
PROGRAM



BOEING



Flying INTO THE future

**ecoDemonstrator program
speeds technology
development that helps
industry and the environment**

*By Karen Crabtree and
photos by Bob Ferguson*

At a lab near Seattle's Boeing Field, Tim Rahmes has spent two years developing new turbulence and water vapor sensors that, if successful, would allow commercial airplane pilots to stop hunting for the smoothest air—and wasting precious fuel in the process.

So Rahmes, lead engineer and principal investigator on the project, has a lot riding on the outcome of the 2014 ecoDemonstrator program. His improved weather forecasting tools, and the algorithm he developed to run them, will be among 30 environmental technologies tested on board a specially outfitted 787 during several weeks of test flights over the remote desert of Moses Lake, Wash.

"I'm excited to fly this and highlight things I know will be groundbreaking

PHOTO: The 2014 ecoDemonstrator test airplane, a 787-8, taxis at Moses Lake in Eastern Washington. The airplane has been specially outfitted to flight-test 30 environmental technologies.

for the industry,” Rahmes said. “Having better weather forecasting information to improve flight efficiency and reduce fuel use—that helps everyone in our industry.”

Boeing’s ecoDemonstrator program, launched in 2011, is designed to speed up the process of testing and refining new technologies to improve aviation’s environmental performance. The program’s first test flights were conducted in 2012. That year, the program used an American Airlines 737-800 as its flying laboratory, or test bed, to evaluate 15 technologies. One of them, natural laminar flow technology, was later incorporated into the 737 MAX Advanced Technology Winglet design to further enhance the airplane’s fuel efficiency.

This year the ecoDemonstrator program has doubled in size, testing technologies from software that will provide pilots with improved weather and route information to hardware designed to lower weight, save fuel and reduce airplane noise heard on the ground. The program’s 787 began early test flights in July, but the majority of the testing will take place this fall.

“The ecoDemonstrator program picks up the pace of development, and that helps engineers get excited about technology development,” said David Akiyama, ecoDemonstrator program manager.

The 787 ecoDemonstrator flights will help evaluate such innovations as advanced navigation landing systems, enhanced aerodynamics, and airplane parts made from recycled materials such as carbon fiber. Additionally, the ecoDemonstrator teams are working toward a paperless flight deck, potentially eliminating the 40 to 50 pounds (18 to 23 kilograms) of charts and paperwork that pilots bring on board, by testing mobile devices such as tablets on the

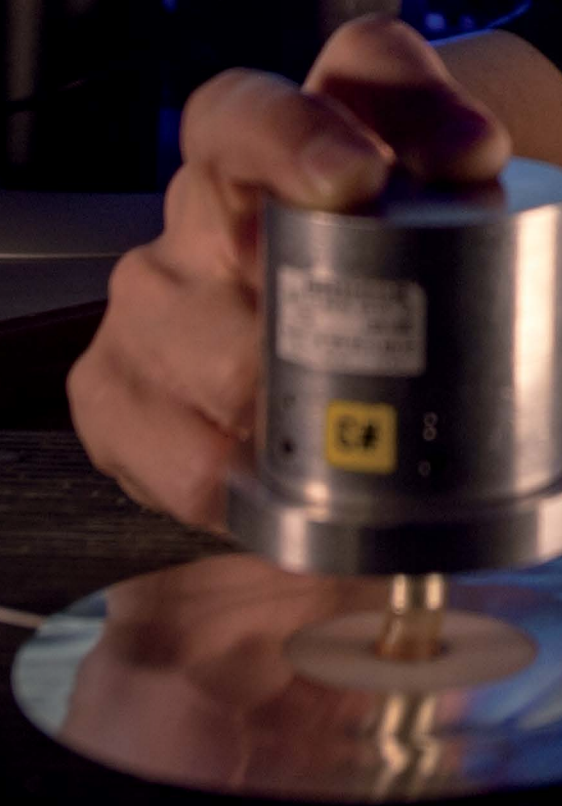
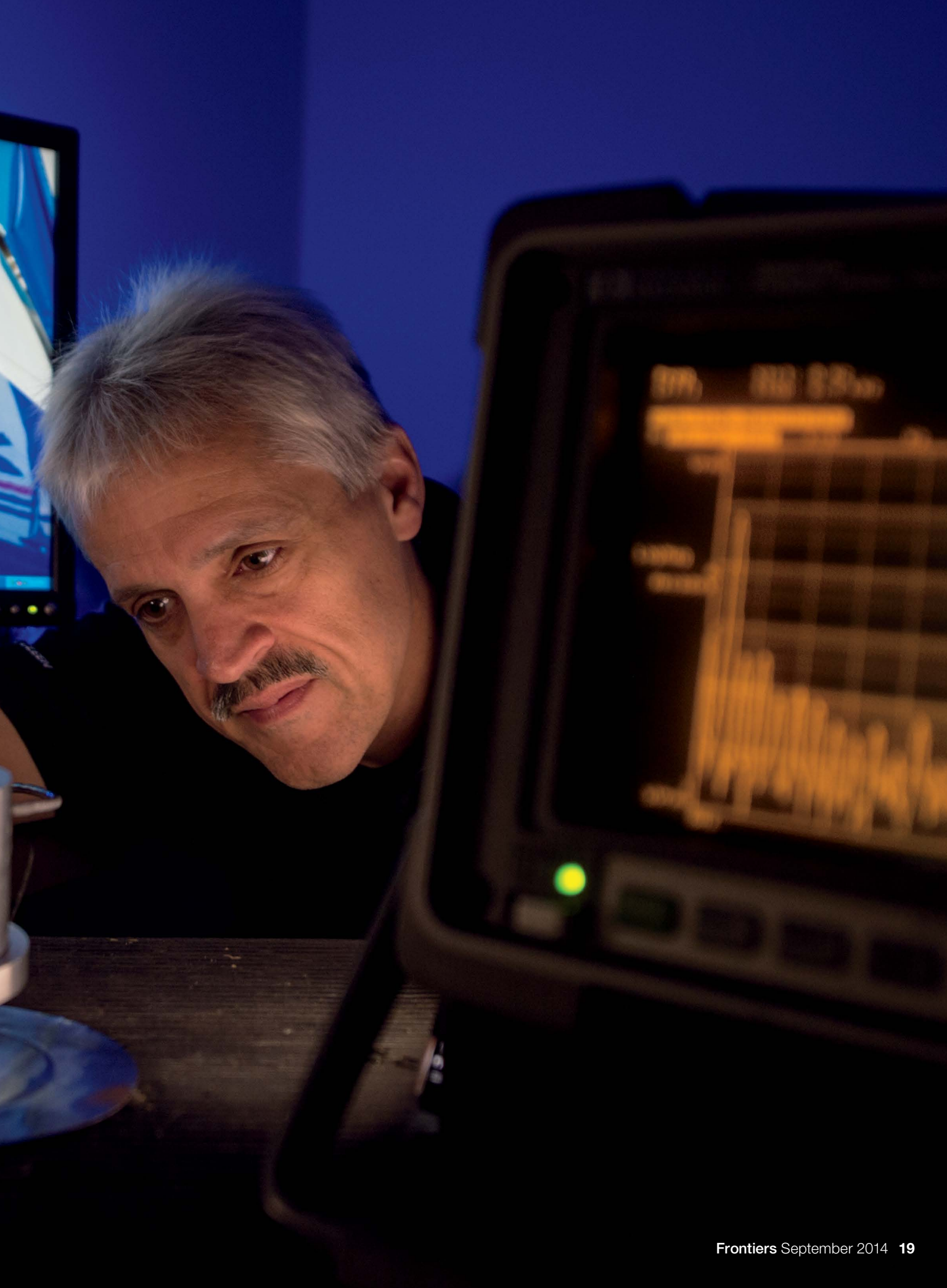


PHOTO: Jim Underbrink, of Boeing Test & Evaluation Instrumentation & Data Systems, uses a calibration device to determine sensitivity on a microelectromechanical system, or MEMS, microphone that was tested as part of the ecoDemonstrator program.



flight deck, said Brian Gilbert, flight-deck displays lead.

While the touch-screen mobile devices will be used to provide pilots with more real-time data to fly more-efficient routes, converting installed flight-deck hardware controls to touch screens saves weight in the flight deck, which contributes to improved fuel use.

Collectively, these innovations could point the way to the next big advance in aviation, explained Jeanne Yu, Boeing Commercial Airplanes director of Environmental and Features Strategy.

“It’s like the saying, Many raindrops make a river,” Yu said. “It’s not that one technology solves everything, and it’s not one big problem we are solving. It’s a lot of technologies—we are working on all those many technologies that will add up to a big benefit.”

Boeing is the only major airplane manufacturer with a test plane dedicated exclusively to evaluating environmentally progressive technologies, according to Akiyama.

Traditionally, engineers designed new technologies to coincide with the introduction of upcoming airplane models or derivatives, Akiyama pointed out, which resulted in 10- to 15-year lags between opportunities to see their technologies in action in a flight-test program. The ecoDemonstrator, with a full schedule of test flights every 12 to 18 months, allows new technologies to be tested as soon as they are ready, speeding implementation on commercial jetliners.

Boeing has tested new technologies through airborne “demonstrators” since at least the early 2000s, when it completed two Quiet Technology Demonstrator programs. The noise-canceling chevrons, or serrated edges, visible on the engine casings of today’s 747-8 and 787 Dreamliner, grew from that program.

Aviation already is one of the most environmentally efficient ways to travel. Julie Felgar, Commercial Airplanes managing director of Environmental Strategy and Integration, said new airplanes are comparable to electric cars in the amount of fuel they use

per passenger mile. But with fuel costs jumping to nearly 40 percent of an airline’s operating costs, even a 1 percent reduction can have a big impact on an airline’s bottom line.

Conscious of the need to minimize its environmental footprint, the industry has established big goals for the future of airline travel, including a commitment to carbon-neutral growth from 2020 and a 50 percent reduction in carbon emissions by 2050.

“That’s not a lot of time,” Felgar said.

“The ecoDemonstrator program allows us to accelerate along that timeline to meet those goals. For me, that’s the most exciting part—to see how the ecoDemonstrator inspires our suppliers, customers and others in our industry.”

The program, managed by Commercial Airplanes Product Development, leverages





PHOTO: Bill Lucyk, left, and Derek Baesler of Boeing Test & Evaluation complete checks on installation of the engine exhaust nozzle made of ceramic matrix composites, designed to make engines quieter, lighter and more efficient.

“The ecoDemonstrator program picks up the pace of development, and that helps engineers get excited about technology development.”

—David Akiyama, ecoDemonstrator program manager



the talents of employees in Boeing Research & Technology, Boeing Test & Evaluation, and many Commercial Airplanes departments, including Environmental Strategy, Engineering, and Commercial Aviation Services and Supplier Management.

The ecoDemonstrator program also works with airline customers, suppliers and NASA and in support of the Federal Aviation Administration's CLEEN program, short for Continuous Lower Energy, Emissions and Noise. Felgar said the ecoDemonstrator program "motivates agencies like the FAA and NASA to actively seek technologies they could test on the ecoDemonstrator. The whole program draws everyone along on the timeline."

Earlier this summer, the FAA CLEEN program completed flight testing of an engine exhaust nozzle made of ceramic matrix composites, developed by Boeing Research & Technology, on the ecoDemonstrator 787 Test Airplane. Ceramic matrix composites are designed to make engines quieter, lighter and more efficient. The CLEEN program is a competitively bid five-year program, with costs shared by participants.

"The nozzle is a great example of how we are working together within Boeing and externally with a government customer to accelerate the maturity of a technology that can benefit industry, airlines and the flying public," said Craig Wilsey, Boeing's CLEEN program manager.

Both the FAA and NASA engage in research to advance the science of aerospace for public benefit. However, the application of government research to commercial products is industry's responsibility, Felgar said.

Teams are already at work installing equipment on the 2015 flying test bed, a leased 757 that will fly next summer with airline customer TUI Travel PLC, the largest tourism group in the world. Boeing is working with NASA on nanotechnology surface coatings to lower the accumulation of insect residue on the wing leading edge to reduce drag. In addition, Boeing and NASA are testing active flow control on the 757's vertical fin, which could result in the

design of a simpler, smaller structure to reduce weight and improve fuel use.

Other on-board technologies planned for 2015 include interiors made of more sustainable materials, lower-weight flight-deck components and fuel indicators, and high-speed data communications for more efficient flight. In addition, the next phase of testing will begin on a variable area fan nozzle that alters the geometry of the engine fan duct during flight, for reduced fuel consumption. The initial prototypes were flight-tested in 2012.

Loading multiple technologies onto each test flight saves time and money—and it energizes employees working in research and development, Akiyama said.

In some cases, engineers see their technology offered to the market within two years. That was the case for several technologies tested on the 2012 ecoDemonstrator that are now offered by Jeppesen, a Boeing subsidiary, for the general aviation market. Engineers always will rely on wind tunnels, simulations and analysis in the development of technology, Akiyama said, but there's no substitute for seeing everything work together on the airplane.

"The actual flight conditions—how the airplane operates as an integrated system, all the variables tested—it gets you there faster than analysis and wind-tunnel tests will," Akiyama said.

It also reduces the risk of production and operational error.

"Moving quickly and learning faster means we identify production risks faster. Prototypes help us prove the technology before we introduce it," Yu said. "It is about future generations—how do we leave aviation better than we came into it?" ■

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View a related video at boeing.com/frontiers/videos/september14.

PHOTO: The ecoDemonstrator 787 test airplane is silhouetted against a bright sky over Moses Lake in Eastern Washington during tests earlier this summer.

Power couple

An AH-64E Apache, top, and its smaller sibling, the AH-6i light attack and reconnaissance helicopter, maneuver in the Arizona desert near Mesa, where Boeing employees build both aircraft. The AH-6i, also known as Little Bird, includes many of the advanced technologies and capabilities of the bigger Apache.

PHOTO: BOB FERGUSON/BOEING

To download and print this poster, visit boeing.com/frontiers/downloads.





SMALL SITES, ■ big OPPORTUNITIES

Neighboring sites in Pennsylvania may be small, but they play important roles for Boeing—and for warfighters

By Richard Esposito and photos by Bob Ferguson

During his 23 years as a U.S. Marine, Keith Johnson made 1,698 parachute jumps. He knows the exact number because he has a record of every one—321 low-level static line jumps and 1,377 free-fall jumps. On many of those jumps Johnson carried a piece of equipment made by Boeing that he hoped he would never have to use—an emergency rescue locator.

“All of our team members had it on

our backs as an emergency radio we’d use if we needed it,” Johnson recalled. “I never used it. But I knew it was there.” Just in case.

Johnson left the Marine Corps about a year and a half ago and joined Boeing. He’s a senior quality engineer at Boeing’s manufacturing facility

PHOTO: Keith Johnson, left, and Jamie Rietheimer inspect a recently assembled Combat Survivor Evader Locator, or CSEL, radio.







in Smithfield, Pa.—the very site that makes and repairs those emergency locaters he wore when he jumped out of aircraft as a Marine.

The Boeing Combat Survivor Evader Locator, or CSEL, as it is called, is but one of the growing number of programs at Smithfield, which comprises a factory site in Smithfield proper and a smaller test and assembly facility about 8 miles (13 kilometers) away at Lemont Furnace.

Johnson is one of some 125 people employed at the main Smithfield site, which, in addition to the CSEL, makes electrical, radio-frequency and fiber-optic cables and harnesses; electronic panels and boxes; radio-frequency systems and antennas; and electro-optical and infrared systems.

These southwest Pennsylvania area facilities became part of Boeing in 2010 when Boeing acquired Argon ST, a leading developer of

command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR), as well as combat, systems.

Argon ST opened the Smithfield facilities in 2003 to build Surface Ship Torpedo Defense systems for the U.S. Navy. Also known as “Nixie,” the acoustic jamming system is used on almost all of the Navy’s surface combatants to defend against torpedo threats. A device is towed about 2,100 feet (640 meters) behind the ship and acts like a decoy, using sound as a countermeasure to distract an incoming torpedo.

More than 400 Nixie systems have been delivered to the U.S. Navy and some international customers.

Most parts of the system are assembled at Smithfield’s larger facility, and the system’s towed decoy bodies are now manufactured at Lemont Furnace,

where Nixie systems are tested in a 500,000-gallon (2.3-million-liter) acoustic tank.

Meanwhile, more Boeing work is going to Smithfield these days—a sign of the times, literally.

The main Smithfield building kept its Argon ST sign until earlier this year, when a large new Boeing monument sign was put in its place. The change did not go unnoticed.

“People would stop in and say ‘Hey, when did you guys become Boeing?’ and then they’d ask where they could apply,” said Mark Smith, senior operations manager and second in command at the site. “This definitely

PHOTOS: (Opposite page) Jessica King applies a sealing compound to a CSEL radio. (Above) Shown performing CSEL assembly tasks at Smithfield, Pa., are (clockwise from top) Ron Miniafee; Ron Naviglia, left, and Denny Carr; and Ken Nudo.

put us on the map here.”

The new sign’s installation coincided with the emergence of promising new opportunities for the site as Boeing shifts more cutting-edge work to Smithfield.

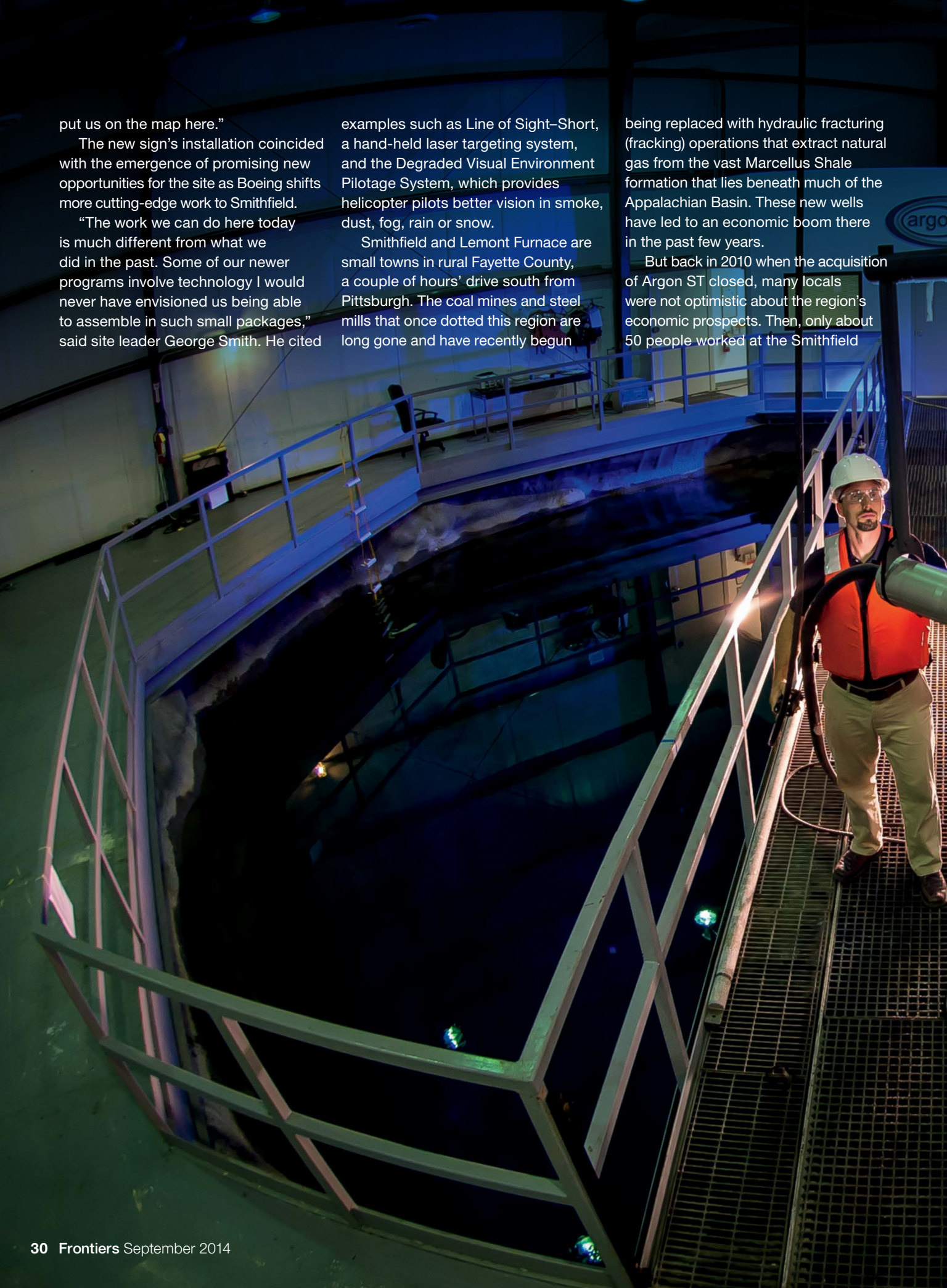
“The work we can do here today is much different from what we did in the past. Some of our newer programs involve technology I would never have envisioned us being able to assemble in such small packages,” said site leader George Smith. He cited

examples such as Line of Sight–Short, a hand-held laser targeting system, and the Degraded Visual Environment Pilotage System, which provides helicopter pilots better vision in smoke, dust, fog, rain or snow.

Smithfield and Lemont Furnace are small towns in rural Fayette County, a couple of hours’ drive south from Pittsburgh. The coal mines and steel mills that once dotted this region are long gone and have recently begun

being replaced with hydraulic fracturing (fracking) operations that extract natural gas from the vast Marcellus Shale formation that lies beneath much of the Appalachian Basin. These new wells have led to an economic boom there in the past few years.

But back in 2010 when the acquisition of Argon ST closed, many locals were not optimistic about the region’s economic prospects. Then, only about 50 people worked at the Smithfield



site, which had recently lost a mainstay contract that in prior years had helped the site support up to 150 employees.

Leanne Phillis, a 10-year Smithfield employee who has spent the past three years in program management, recalled what it was like.

“When Boeing bought us, I thought, What does a small site like this one mean to big Boeing? We’re just a handful of people in a small town in Pennsylvania. So let’s just say that

we waited with bated breath.”

But in 2012, the site became part of Boeing’s Electronic & Information Solutions organization, and work from other parts of the company began flowing to Smithfield. It made good business sense because the Smithfield team’s capabilities were a strategic asset worth keeping, according to Derek McLuckey, director of Operations for Electronic & Information Solutions.

“The team in Smithfield is flexible,

agile and quick to set up new things and adjust to program changes,” McLuckey said. *“They’re extremely competitive commercially and can go head to head with outside companies in terms of capabilities, infrastructure and overhead costs. It’s actually a*

PHOTO: Dan Monticelli, left, and Mike Putt prepare a Nixie decoy for acoustic testing in Lemont Furnace’s 500,000-gallon (2.3-million-liter) tank.



differentiator for them. They have great business sense and energy.”

The unexpected liquidation of a key Boeing subcontractor in 2012 created one of the first big tests of Smithfield’s responsiveness and capability. The liquidation immediately jeopardized two longtime programs within Electronic & Information Solutions—CSEL and the Gigabit Ethernet Data Multiplex System, or GEDMS, a shipboard network that manages data from multiple systems on all U.S. Navy destroyers as well as other U.S. and non-U.S. naval vessels. The subcontractor’s impending closure threatened to trap extensive stocks of raw materials, tooling and work-in-progress inside a shuttered factory. Boeing had to act fast.

Three months later, repair and production lines for both programs were up and running at Smithfield.

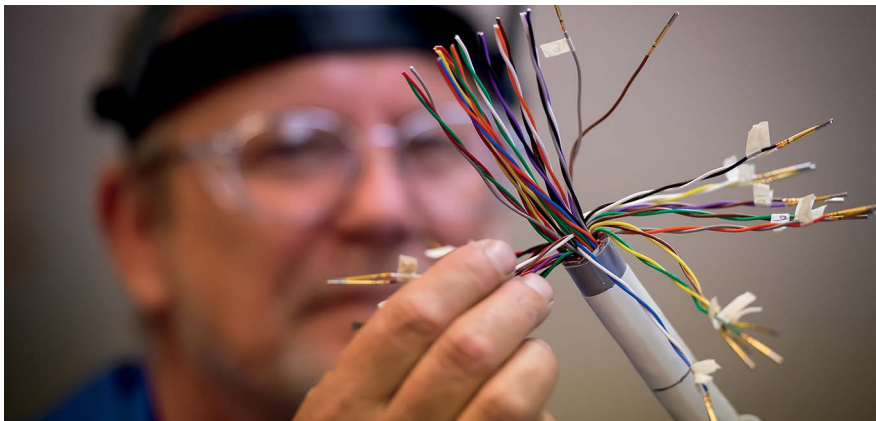
“For CSEL, we had to develop an entirely new and more efficient work-flow process, transform our material requirements planning system to accommodate the larger

volume of CSEL radios, and retrain every individual on the CSEL program,” said Elliot Galand, the site’s CSEL program manager.

Today, site employees proudly retell the story of how CSEL and GEDMS got started in Smithfield.

“One of the things that makes everyone here more diligent in their jobs is the knowledge that these radios are used by soldiers





in the field,” said John Locke, who has assembled CSEL radios at Smithfield for the past year.

“That’s a pretty big responsibility,” he added. “You’re not working just for yourself anymore. You’re working for a warfighter who has no idea who you are, but they trust in the product because it’s coming from our company name—so they know it’s going to work for them.”

In addition to CSEL, other longtime and new programs are filling both the main Smithfield facility’s 65,000 square feet (6,000 square meters) of space and Lemont Furnace’s 36,000 square feet (3,300 square meters).

The Lemont Furnace facility includes a 10-member engineering and design team. Shawn Johnson, who leads the team, said recent efforts to “co-market” Smithfield’s manufacturing capabilities with his team’s design and engineering services have led to still more interest around Boeing.

“This place is unique not only in Boeing but also within the Navy and acoustics community,” Johnson said of Lemont Furnace. “Not many places have an environmentally controlled in-water test facility that is this big and has the capabilities we bring. Once people realize what we have

here, we can do more collaboration with other groups that have an acoustic design requirement or an acoustics test requirement. We’re also fortunate to have a small group of great engineers here.”

Whether they work at the Smithfield or Lemont Furnace location, employees use words such as “like family” to describe the work environment.

Heather Smith, an accountant at the Smithfield facility, has been there since it was opened by Argon ST.

“Now that we’re growing, it is a great opportunity,” she said. “For me, being a local person, there wasn’t much opportunity in this area without moving away. We never thought we’d have an opportunity here like this. That’s what I consider unique, that Boeing actually came to a small town like this.” ■

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PHOTOS: (Opposite page) Shown performing product inspections at Smithfield, Pa., are (clockwise from top left) Earl Forsythe, left, and Barb Stossel; Jackie Bryner; and Clifford Tracy. (This page, from top) Jeff Evans, left, and Tonya Potteiger inspect the workmanship of the main electrical distribution center for an aircraft; Don Yingling terminates a fiber-optic test cable.



AFRICA ON THE



MOVE

Sub-Saharan Africa presents a major market opportunity for Boeing

By Bill Seil

More than a half-century ago, in 1960, Boeing delivered a 707 to South African Airways, launching commercial jet service on the continent of Africa. This historic event represented not just a new and faster mode of transportation to millions of people; it provided an important transportation resource to accelerate the opening of markets and facilitate economic growth.

More than 50 years later, Boeing serves more than 40 airline customers on the continent, with a fleet representing about

62 percent of the market. Kenya Airways and Ethiopian Airlines are operating the advanced 787 Dreamliner. Comair in South Africa has ordered the 737 MAX.

Economic growth in the vast, resource-rich African continent is bringing new opportunities to its people. Ten of the 15 fastest-growing countries in the world are in Africa, and by 2035 it is expected to have a larger workforce than India or China, according to Boeing's *Current Market Outlook*. Sustaining and expanding

this growth is critical to Africa's future and a primary development goal of countries across the continent.

Commercial aviation—both passenger and cargo—is key to economic development and creating jobs on the continent, which has a limited transportation infrastructure. There also is a rapidly expanding middle class and airlines are

PHOTO: A view of Cape Town, South Africa's second-most-populous city. SHUTTERSTOCK

preparing for an increased demand for air travel. Boeing is forecasting a market for 1,080 new commercial airplane deliveries in the continent over the next 20 years.

Boeing's future success in sub-Saharan Africa—all countries south of Morocco, Algeria, Tunisia, Libya and Egypt—depends, in part, on partnering with its key customers in the region as they lead the way in expanding commercial aviation throughout the continent, according to Van Rex Gallard, Commercial Airplanes' vice president for sales in Africa, Latin America and the Caribbean. This includes working in cooperation with these customers to ensure that Africa has the essential tools and services it needs to expand its aviation industry.

"We can contribute to this growth," he said, "by working with the airlines to make sure that they have the right infrastructure to operate efficiently and help drive economic expansion."

Meanwhile, Boeing's military aircraft legacy in Africa dates back to World War II, when heritage company Douglas Aircraft established a top-secret aircraft

maintenance facility in Ethiopia to serve Allied air commands in North Africa.

While Boeing Defense, Space & Security has had little presence in sub-Saharan Africa, it is seeing new opportunities for the sale of fixed-wing and heavy-lift rotorcraft to meet humanitarian and security needs. Reconnaissance aircraft and unmanned aerial vehicles are needed for patrolling borders, controlling sea lanes and detecting wildlife poaching. Commercial Airplanes is supporting Defense, Space & Security by providing information and connecting the business to local contacts.

At the Farnborough International Airshow in July, Defense, Space & Security signed a memorandum of collaboration with the Paramount Group, Africa's largest privately owned defense and aerospace business, to jointly develop defense and security opportunities around the continent, a significant step forward in Boeing's efforts in Africa.

Boeing will be introducing products to this market at this month's Africa Aerospace and Defence air show in South Africa.

The sub-Saharan region varies widely

in terms of standard of living, stability and economic development. But there are areas where local enterprise and outside development are opening long-term opportunities for the continent.

Shep Hill, president, Boeing International, and senior vice president, Business Development and Strategy, said sub-Saharan Africa is ready to benefit from a growing airline industry.

"Sub-Saharan Africa presents a huge market opportunity for The Boeing Company, in part because of its geography," Hill said. "There are great distances to be traveled, yet they lack an integrated transportation infrastructure. Aviation can help fill that need."

While sub-Saharan Africa still has a long way to go, it is on a gradual urbanization path and the quality of life for its young population is improving, Hill said. Air travel is becoming more affordable to average citizens, and air cargo is essential to the growth of commerce and local employment.

Hill cautioned, however, that while the continent as a whole offers excellent long-term opportunities, immediate business opportunities will be sought



on a country-by-country basis. Africa remains a very diverse continent of more than a billion people and not suitable for one grand strategy.

Miguel Santos, Boeing International's managing director for sub-Saharan Africa and Commercial Airplanes' director of International Sales for southern Africa, noted the region is rich in natural resources including oil, natural gas, iron ore and coal. The sale of these resources is allowing African nations to expand their infrastructure, including major improvements to airports in southern and eastern areas of the continent. Construction companies, consultants and financial institutions have moved in, and there is a growing potential for industrial development.

"Sub-Saharan Africa is exciting because it's the last region in the world that is primed for major development," Santos said. "The United States and Europe are the two greatest consumer markets in the world, and Africa is geographically well-positioned to

PHOTO: A 787 Dreamliner in Kenya Airways livery. COLLEEN PFEILSCHIEFTER/BOEING

AIR TRAVEL: FUELING THE ECONOMY, CONNECTING WITH THE WORLD

Commercial airlines are among the forces driving growth and economic development in sub-Saharan Africa. Airplane traffic is at the heart of the continent's transportation infrastructure and a vital link to the global economy.

Ethiopian Airlines was the first African carrier to order the 787 Dreamliner—10 787-8s in February 2005, with the first delivered in 2012. In 2013, the airline took delivery of its first 777-300ER (Extended Range), and its total fleet now includes nearly 50 Boeing airplanes. Ethiopian Airlines serves destinations in five continents.

"Ethiopian Airlines is a jewel of an operator," said Van Rex Gallard, Commercial Airplanes' vice president for sales in Africa, Latin America and the Caribbean. "The leaders of Ethiopia decided that aviation was going to be a key machine to fuel the economy of their country. So they made a major investment in advanced equipment and hired some of the best people available."

Ethiopian Airlines is also a Boeing supplier, providing wire harnesses for all Boeing commercial airplane programs.

Kenya Airways placed an order for nine 787-8s in 2006 and took delivery of its first Dreamliner earlier this year. In addition to the 787, the airline operates an all-Boeing long-haul fleet of six 767-300ERs, four 777-200ERs and three 777-300ERs. It serves more than 60 destinations across Asia, Africa, the Middle East and Europe.

TAAG Angola Airlines has been a Boeing customer since 1975. Over the years, its fleet has grown to include five 737-700s, three 777-200ERs and three 777-300ERs. In April 2012, the airline announced an order for three 777-300ERs, the first of which was delivered in June of this year.

South African Airways, which launched commercial jet service on the continent with Boeing's 707 in 1960, also was the first African carrier to take delivery of a Boeing 747. The government-owned airline is looking ahead to the modernization of its fleet.

Comair, based in South Africa, in March of this year announced an order for eight 737 MAX jetliners—the first order for the MAX announced by an African operator. The airline also operates four Next-Generation 737-800s, with four more on order.

In late 2013, LAM Mozambique Airlines ordered three 737-700s. The carrier operates flights domestically and regionally across southern Africa. Other Boeing customers in the region include Arik Air, based in Nigeria, and Air Austral, based in Reunion Island, located east of Madagascar, as well as Air Madagascar, TACV Cabo Verde Airlines and Rwanda's RwandAir. ■

AFRICA MARKET FORECAST

122 MILLION

Africa's labor force is forecast to grow by 122 million people by 2020 and become a total workforce that will surpass that of China or India by 2035.

Source: Boeing Current Market Outlook

6 PERCENT

Air traffic to, from and within Africa is projected to grow about 6 percent per year for the next 20 years, driven by the economic outlook, increasing trade links and the growing middle class.

1,100 AIRPLANES

Africa is forecast to require about 1,100 new airplanes over the next 20 years, approximately two-thirds of which will expand the region's fleet.



export goods to these regions.”

While there are great opportunities for Boeing to partner with growing African nations, the company's employee presence in the region consists of airline support personnel. Still, Boeing has strong relationships with its airline customers and a solid foundation to build on. This can include offering needed services, technologies and training to the airlines.

In sub-Saharan Africa, smaller carriers often rely on larger carriers for maintenance and engineering services. In some cases, these services are provided by companies from outside the continent, said Ed DeAlbuquerque, regional director for African sales, Commercial Aviation Services. He noted that Boeing is marketing its consulting and training services to help African airlines develop the maintenance and engineering skills to maintain their own fleets.

While Boeing does not operate pilot-training facilities in sub-Saharan Africa, the company does partner with 43 Air School in South Africa to offer a “Fast Track to First Officer” training program. Ethiopian Airlines operates its own pilot-training academy, which includes time in simulators.

Boeing also offers African carriers its latest digital efficiency tools, including Boeing Airplane Health Management, Toolbox and GoldCare Virtual Maintenance Engineering.

“The people at these airlines are eager, ambitious and extremely bright

when it comes to adapting to the latest technologies,” DeAlbuquerque said. “The infrastructure is starting to take shape.”

Paul Oliver, Defense, Space & Security's vice president, Middle East and Africa, International Business Development, said his business unit is just starting to explore opportunities in sub-Saharan Africa. Fortunately, the Boeing brand is strong in the region—because of the presence of Boeing jetliners.

“Our Commercial Airplanes counterparts have really been a great help in introducing us to their contacts, setting up meetings and helping us understand the customer set that we're dealing with,” Oliver said. “It's been a great ‘One Boeing’ experience.”

While Oliver doesn't expect major sales in the region in the near term, he does see excellent prospects looking ahead five to 10 years, and decades down the road.

“To be successful, we've got to invest time and start helping them solve their problems,” Oliver said. “This means working to become part of the fabric of their countries.”

Tiffany Richardson, Defense, Space & Security's International Business Development lead for Africa, said the company is forming alliances with aerospace-related companies that already have a strong presence in the region. Alliances can help market Boeing products on the continent and make services affordable to African countries.

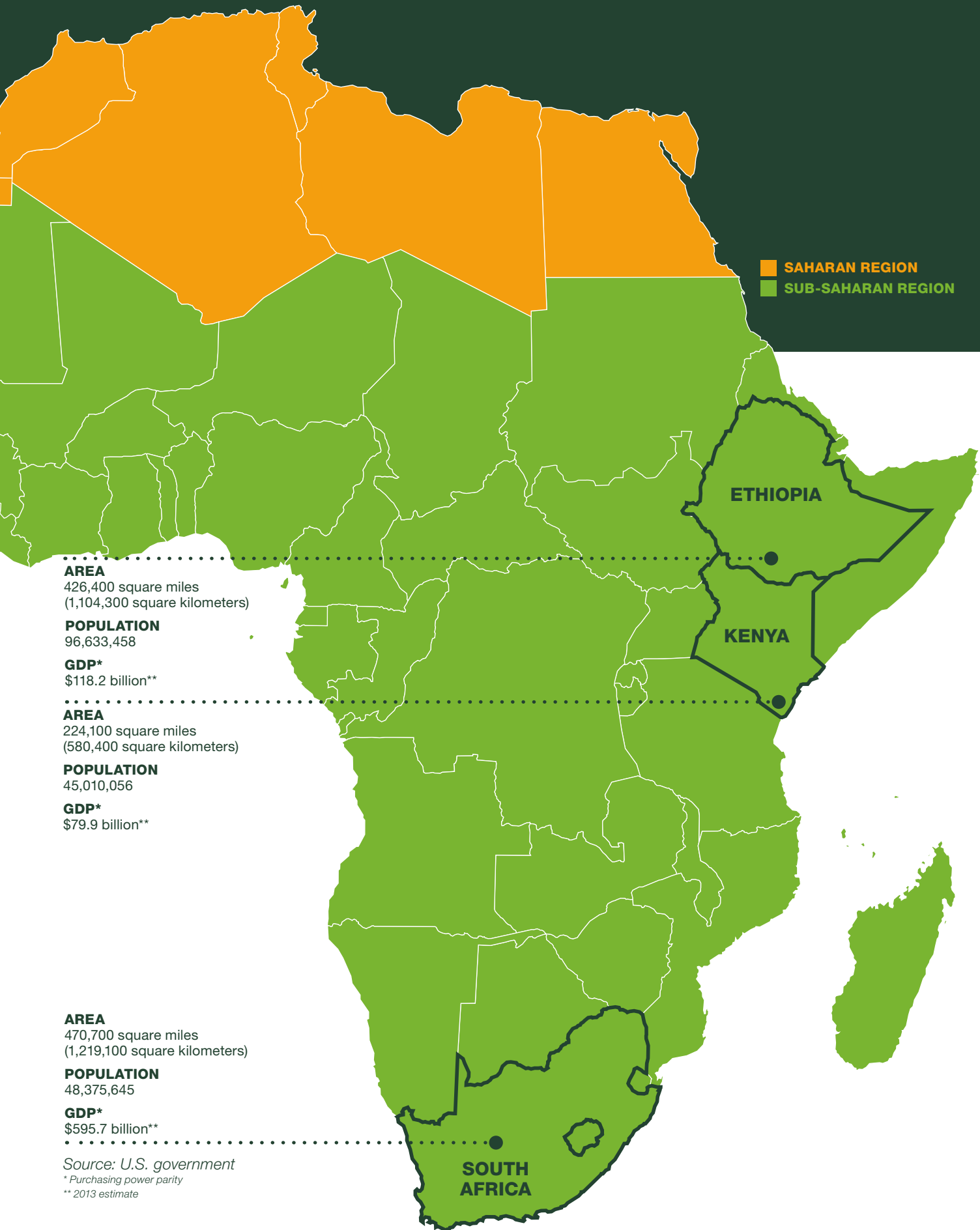
Africa's vast geography and

limited ground transportation make air transportation essential. Richardson pointed out there is a strong market for CH-47 Chinook helicopters to transport military personnel and carry out humanitarian missions.

Surveillance aircraft and unmanned aerial vehicles also can be a great asset to local governments in preventing poaching, detecting criminals trafficking in people or drugs, and preventing attackers from storming oil platforms or boarding ships, Richardson said. Boeing sees a market for ScanEagle and Integrator unmanned aircraft systems and, in some cases, the AH-6i Little Bird helicopter.

Sub-Saharan Africa's natural resources have opened the door to research and development opportunities in the region, according to Bill Lyons, director, Global Technology, Boeing Research & Technology. Two areas of particular interest are sustainable aviation biofuel and processes that could lead to the conversion of titanium powder to titanium parts for aircraft.

Lyons said South Africa has abundant supplies of titanium powder, which is mined primarily from mineral sands. In 2013, Boeing and South Africa's Council for Scientific and Industrial Research announced that they would conduct joint research on ways to incorporate titanium powder into industrial manufacturing processes. This mutually beneficial research collaboration supports South Africa's







MAKING A DIFFERENCE

Whether helping farmers in Kenya or working with local officials to improve educational opportunities for schoolchildren in South Africa, Boeing Global Corporate Citizenship programs are making a difference on the continent.

In Kenya, poor rural farmers are improving their quality of life by developing modern business skills and learning to handle personal finances. The training is provided by Village Enterprise Fund, one of several community improvement projects supported by Boeing in Ethiopia, Kenya, Nigeria and South Africa.

The Village Enterprise program helps Kenyan farmers adopt business practices that use their land more productively. For example, one family, in addition to receiving business training, was provided with a foot-powered water pump to irrigate its land. Increased income went toward food purchases and education for the family's children.

Coleen Burke-Finney, director, International Policy Integration, said Boeing Global Corporate Citizenship programs in sub-Saharan Africa focus on pressing local needs for advancements in education, workforce skills, economic development, and health and human services.

"All of our community and economic development investments in these countries are intended to provide meaningful benefits to local communities and help them reach their potential," Burke-Finney said.

In Ethiopia, the Connected in Hope program established a holistic early education center for 50 children. It also helps women develop incomes and strengthen their families.

In South Africa, the Symphonia program mobilizes business and community leaders to partner with school principals and educators to improve the quality of elementary education.

Boeing also is working with local partners to expand opportunities for farmers in Southern Africa to grow crops that can be used to produce sustainable biofuels. ■

long-term economic development and could expand the supply of titanium for many industries, including aerospace.

Boeing also is working with South African Airways to develop a sustainable biofuel supply chain in Southern Africa, which helps to address a key priority for the airline and government. As part of that effort, Boeing and the airline are working with the Roundtable on Sustainable Biomaterials to expand opportunities for "smallholder" farmers in Africa to grow crops that produce sustainable biofuels.

Boeing, South African Airways and SkyNRG recently announced that they are collaborating to make sustainable aviation biofuel from a new hybrid tobacco plant called Solaris. Test farming of the plant is currently underway in South Africa with biofuel production expected from large and small farms in the next few years.

Projects such as these underscore that Africa is a vast continent with huge potential, marked by areas of poverty and unrest. And Boeing, according to Hill, is partnering with nations that are taking the lead in creating a 21st-century Africa that will play a growing role in the global economy. ■

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PHOTOS: (Far left) In Ethiopia, preschool children in the Boeing-supported Connected in Hope program participate in an art class. **CONNECTED IN HOPE** (Above) Africa is a potentially large market for Boeing unmanned aircraft systems (left) and the CH-47 Chinook (right). **BOEING**

MILESTONES



IN FOCUS

Roll model

A U.S. Air Force F-15C Eagle with “splinter” camouflage paint scheme rolls inverted over Nellis Air Force Base in Nevada in early July. The F-15C is with the 65th Aggressor Squadron, part of the 57th Adversary Tactics Group at Nellis AFB. The flight was a training run-up for a Red Flag exercise held there later that month. Red Flag is the Air Force’s premier air combat training event and the Aggressor aircraft emulate various opposition aircraft. Boeing employees build the F-15 in St. Louis.

PHOTO: JIM HASELTINE/HIGH-G PRODUCTIONS

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A Boeing quer que os jovens brasileiros cheguem ainda mais longe. Por isso, investe em projetos que levam educação, inovação e competitividade a estudantes, desde a pré-escola até a universidade. Instituto Ayrton Senna, programa Ciência Sem Fronteiras e competições de aeromodelismo são algumas das iniciativas e parcerias da Boeing que estão ajudando a transformar o futuro de crianças e jovens no Brasil.



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