

ARCHIVED REPORT

For data and forecasts on current programs please visit

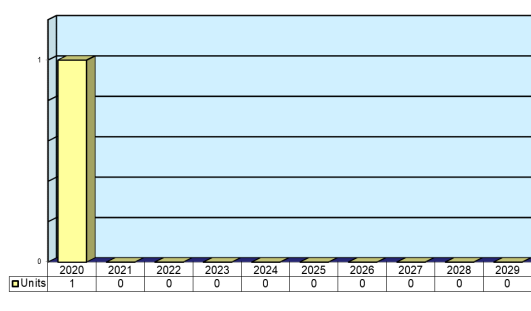
www.forecastinternational.com or call +1 203.426.0800

Embraer Legacy 650

Outlook

- Production of the Legacy 650E ended in mid-2020
- The 650E competed in the large-cabin jet class

Unit Production Forecast
2020-2029



Orientation

Description. Family of business jets derived from the ERJ 135 regional airliner.

Sponsor. The Legacy 650 and Legacy 650E were sponsored privately by Embraer.

Status. Production ended in mid-2020.

Total Produced. Through 2019, Embraer produced approximately 185 Legacy 600s and 118 Legacy 650/650Es.

Application. Business/executive transportation.

Price Range. Legacy 650E, estimated at \$25.9 million in 2020 U.S. dollars.

Contractors

Prime

Embraer (Empresa Brasileira de Aeronautica SA)	http://embraer.com , Av Brigadeiro Faria Lima, 2170, Sao Jose dos Campos, São Paulo, Brazil, Tel: + 55 12 3927 1000, Fax: + 55 12 3927 6600, Prime
---	---

Subcontractor

Aleris Aluminum (Zhenjiang) Company Ltd, Zhenjiang Rolling Mill	http://www.aleris.com , No. 111 Caijia Rd, Jingkou Industrial Zone, Zhenjiang, Jiangsu, China, Tel: + 86 511 85307287, Email: Info.China@aleris.com (Aluminum Flat Rolled Products)
Aleris Rolled Products Germany GmbH	http://www.aleris.com , Carl-Spaeter-Strasse 10, Koblenz, Germany, Tel: + 49 261 891 0, Email: Info.Europe@aleris.com (Aluminum Flat Rolled Products)
Duncan Aviation	http://www.duncanaviation.aero , Lincoln Airport, 3701 Aviation Rd, Lincoln, NE 68524 United States, Tel: + 1 (402) 475-2611, Fax: + 1 (402) 475-5541 (Interior Components)

Embraer Legacy 650

Honeywell Aerospace, Aviation & Air Transport	http://www.honeywell.com , 21111 N 19th Ave, Phoenix, AZ 85027 United States, Tel: + 1 (602) 436-2311 (Primus Elite Avionics System)
NORDAM Group	http://www.nordam.com , 510 S Lansing, PO Box 3365, Tulsa, OK 74120 United States, Tel: + 1 (918) 587-4105, Fax: + 1 (918) 878-6861 (Interior Components)
Pratt & Whitney	http://www.pratt-whitney.com , 400 Main St, East Hartford, CT 06108 United States, Tel: + 1 (860) 565-4321, Email: info@pw.utc.com (APU)
Rolls-Royce Corp, Plant 8 Manufacturing Facility	http://www.rolls-royce.com/northamerica/na , 2001 S Tibbs Ave, Indianapolis, IN 46225 United States, Tel: + 1 (317) 230-2000, Fax: + 1 (317) 230-4020 (AE 3007 Turbofan Engine)
Safran Electrical & Power	http://www.safran-electrical-power.com , Parc d'activité d'Andromède 1, rue Louis Blériot, Blagnac, France, Tel: + 33 5 34 28 20 00, Fax: + 33 5 34 60 01 99, Email: communication@fr.labinal.com (Wiring)

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

Technical Data

(Legacy 650E)

Design Features. Cantilever low-swept-wing monoplane with two fuselage-mounted engines. Semi-monocoque fuselage with swept T-tail. Tricycle type landing gear. The main landing gear were twin-wheeled and retracted inward. The nose gear was twin-wheeled and retracted forward.

	<u>Metric</u>	<u>U.S.</u>
Dimensions		
Length	26.33 m	86.40 ft
Height	6.64 m	21.77 ft
Wingspan	21.17 m	69.44 ft
Cabin length	15.19 m	49.83
Cabin height	1.83 m	6.0 ft
Cabin width	2.10 m	6.91 ft
Cabin volume	46.9 cu m	1,656 cu ft
Weight		
Maximum takeoff weight	24,300 kg	53,572 lb
Maximum payload	2,240 kg	4,939 lb
Maximum usable fuel	9,344 kg	20,600 lb
Performance		
Maximum operating speed	Mach 0.80	Mach 0.80
Range with four pax and NBAA IFR reserves	7,223 km	3,900 nm

Propulsion

Legacy 650E (2) Rolls-Royce AE 3007A2 turbofan engines rated 40.1 kN (9,020 lbst) each.

Seating

Crew of two plus up to 14 passengers.

Embraer Legacy 650

Variants/Upgrades

Legacy 600. The Legacy 600 business jet carried up to 14 passengers (plus a crew of two). In designing the aircraft, Embraer extended the wing/fuselage fairing of the ERJ 135 airliner and redesigned the cargo hold to allow for additional fuel capacity. Other modifications included the addition of winglets, and changes to improve short-field performance. The 600 had a range with eight passengers and NBAA IFR reserves of 6,019 kilometers (3,250 nm).

The Legacy 600 was initially powered by a pair of Rolls-Royce AE 3007A1P turbofan engines, each rated 33.0 kN (7,426 lbst). In early 2002, Embraer announced that the 35.4-kN (7,953-lbst) Rolls-Royce AE 3007A1E engine would be available as an option on the Legacy for customers that wanted higher thrust and improved short-field capabilities. With the engine, the balanced field length of the Legacy 600 was reduced to less than 6,000 feet.

The AE 3007A1E became the standard engine on the Legacy 600 in early 2004.

The Legacy 600 was originally equipped with the Honeywell Primus 1000 avionics package. However, Honeywell's Primus Elite avionics suite later became standard on the aircraft.

Embraer no longer markets the Legacy 600.

Legacy 650. Derived from the Legacy 600, the Legacy 650 combined the cabin of the 600 with longer range. The 650 could fly up to 3,900 nautical miles with four passengers, or 3,840 nautical miles with eight passengers.

The Legacy 650 was equipped with Rolls-Royce AE 3007A2 turbofan engines. The AE 3007A2 is a more powerful variant of the AE 3007A1E engine that equipped the 600. The 650 also featured Honeywell's Primus Elite avionics suite.

Compared to the 600, the Legacy 650 incorporated various airframe modifications, such as structural

reinforcements to the wing and landing gear, modifications to the aft section of the wing/fuselage fairing, and installation of detachable (rather than blended) winglets. The revised landing gear resulted in the 650 being approximately 5 inches shorter in height than the 600. Fuel capacity was increased in the 650 with installation of a new underbelly ventral fuel tank and more fuel storage in the central wing box. The 650's fuel system used electrically actuated valves, rather than the hydraulically actuated valves found on the 600. Cabin improvements included a new sound insulation package.

Embraer no longer markets the Legacy 650.

Legacy 650E. In October 2016, Embraer unveiled a new version of the Legacy 650, dubbed the Legacy 650E.

The flight deck of the Legacy 650E incorporated Honeywell's Primus Elite Advanced Features (PEAF) upgrade which, among other features, included a Synthetic Vision System. The PEAF package also added Traffic Collision Avoidance System (TCAS) symbology and XM ground-based weather information to the aircraft's moving map display. The cockpit had a pair of iPads with mounting systems.

The Legacy 650E also featured an autothrottle as standard equipment. The aircraft's interior was configured with three distinct cabin zones. Passenger seats had restyled upholstery.

The Legacy 650E was powered by a pair of Rolls-Royce AE 3007A2 turbofan engines. The AE 3007A2 was the same engine that powered the original Legacy 650 model.

Initial delivery of a Legacy 650E occurred in July 2017, to the German charter outfit Air Hamburg.

Production of the Legacy 650E ended in mid-2020.

Program Review

Background. Following discussions with potential customers at the 1999 Paris Air Show, Embraer announced that it would consider marketing a business aircraft version of its 37-passenger ERJ 135 regional jet. In July 2000, the company launched this variant, which later became known as the Legacy. Two basic versions of the aircraft were marketed: an 8-14 passenger executive jet transport and a 16-37 passenger corporate

shuttle. The former version became known as the Legacy Executive model, while the latter became known as the Legacy Shuttle.

At the time of program launch, Embraer announced two launch customers for the Legacy. One was air charter operator Swift Aviation of Phoenix, Arizona, which ordered 25 Legacy jets and took options for an

Embraer Legacy 650

additional 25. The other launch customer was the Greek Air Force, which ordered one Legacy for use as a government staff transport.

Program Schedule. In December 2000, Embraer began testing one of the original ERJ 135 prototypes (S/N 002) equipped with winglets, dummy fuel tank bodywork, and strakes on the aft fuselage.

The first flight of a new-build Legacy (S/N 363) occurred in March 2001. This aircraft was used for aerodynamics and systems integration tests.

In December 2001, the Legacy received Brazilian certification. Initial delivery of a Legacy occurred in the second quarter of 2002.

The European Joint Aviation Authorities (JAA) granted certification to the Legacy in July 2002. U.S. Federal Aviation Administration (FAA) certification was awarded in September 2002.

Product Enhancements

In October 2003, Embraer announced a range increase of almost 5 percent for the Legacy Executive model. With eight passengers, the aircraft could now fly up to 3,250 nautical miles. The company also announced a number of other improvements to the Executive model, including several new standard features, increased fuel capacity, and various aerodynamic enhancements. The latter included redesigned fairings and air inlets, polished leading edges, smoothed surfaces, and the removal of windshield wipers. A new interior configuration was designed to provide improved comfort and flexibility and enhanced acoustic insulation.

In December 2003, the Legacy was granted authorization by Brazil's Centro Tecnico Aeroespacial (CTA) and the U.S. FAA to expand its takeoff and landing envelope at airports located up to 8,500 feet above sea level. As a result, the Legacy was now able to operate at higher altitude airports in cities such as Mexico City. The authorization extended not only to new Legacy models but also to all previously built examples of the aircraft, as no modifications were required to take advantage of the expanded envelope.

In March 2005, the Legacy received certification from Brazilian, European, and U.S. authorities to raise the aircraft's service ceiling to 12,497 meters (41,000 ft) from 11,887 meters (39,000 ft). The higher service ceiling allowed Legacy pilots to fly above congestion or inclement weather.

In July 2005, Embraer delivered the initial Legacy with an optional high-speed Internet connection. The aircraft was equipped with high-speed-data (HSD) equipment from Chelton and wireless fidelity (Wi-Fi) equipment

from Miltope. These systems allowed customers to browse the Internet, access e-mail, and transfer files.

In September 2005, Embraer announced that the Brazilian CTA and the U.S. FAA had approved the Legacy to operate at airports located up to 2,896 meters (9,500 ft) above sea level.

New Name

In November 2005, Embraer announced that the Legacy had been renamed the Legacy 600. The change was implemented so that the name of the aircraft would be more in line with Embraer's new executive jet nomenclature. Eventually, the Legacy 600 designation was applied specifically to the Legacy Executive model, while the corporate shuttle version continued to be sold as the Legacy Shuttle.

Over time, the Legacy Shuttle name seemed to fall into disuse, as Embraer began marketing the corporate shuttle as an ERJ 135 version rather than under the Legacy brand name. In essence, the shuttle was an ERJ 135LR with a corporate interior. It was not equipped with the winglets and additional fuel tanks of the Legacy 600. It also had a different avionics fit, and was powered by two Rolls-Royce AE 3007A1/3 engines rated 31.4 kN (7,057 lbst) each.

Legacy 650 Introduced

Derived from the Legacy 600, the Legacy 650 combined the cabin of the 600 with longer range. Embraer internally launched the Legacy 650 program in the first half of 2008, but did not publicly announce the aircraft until the October 2009 National Business Aviation Association (NBAA) convention in Orlando, Florida. Prior to this announcement, Embraer had presented the 650 to a limited number of customers, and was able to secure an undisclosed number of firm orders backed by non-refundable deposits.

The initial Legacy 650 made its first flight in September 2009, and a second aircraft followed it into the air just one day later. In October 2010, the 650 was awarded certification by Brazil's Agencia Nacional de Aviacao Civil (ANAC) as well as by the European Union Aviation Safety Agency (EASA). Initial delivery of a 650 occurred in November 2010, to the British firm Amsair Aircraft Ltd.

The Legacy 650 received FAA certification in February 2011.

Chinese Assembly Line

From 2013 to 2016, Legacy 650s were assembled in China as well as Brazil. Assembly in China occurred in Harbin by Harbin Embraer Aircraft Industry Company Ltd, a joint venture between Embraer and the Chinese

Embraer Legacy 650

firm AVIC. The initial Legacy 650 assembled by the joint venture made its first flight in August 2013.

Until April 2011, Harbin Embraer had been building ERJ 145 regional jets. Subsequently, its production line transitioned to the Legacy 650.

In June 2016, Embraer and AVIC announced that the Harbin Embraer joint venture would be phased out. Ultimately, five Legacy 650s were built in Harbin, the last of which was delivered in March 2016.

Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Jul	2000	Embraer launches the Legacy
Mar	2001	First flight
Dec	2001	Brazilian certification
	2002	Initial delivery
Nov	2005	Legacy renamed Legacy 600
Sep	2009	First flight of Legacy 650
Oct	2010	Brazilian and EASA certification of Legacy 650
Nov	2010	Initial delivery of Legacy 650
Feb	2011	FAA certification of Legacy 650
Oct	2016	Legacy 650E announced
Jul	2017	Initial delivery of Legacy 650E
Mid-	2020	Production ends

Forecast Rationale

Embraer withdrew the Legacy 650E from production in mid-2020. The company decided to focus its business jet production activities on its Phenom and Praetor models. One Legacy 650E was delivered in the first half of 2020; this aircraft may turn out to be the last 650E ever delivered.

The evolution of the original Legacy 600 into the Legacy 650 had provided Embraer with a product clearly positioned in the large-cabin business jet class. The 600 certainly had the cabin volume required to compete in the large-cabin class, but its range tended to position it more as a super mid-size jet. However, while

retaining the cabin of the 600, the 650 featured significantly longer range, placing the aircraft squarely within the large jet category.

The 650 was eventually replaced by the Legacy 650E, which featured a number of improvements compared to the original 650. These included enhanced avionics and a revamped interior.

As was true for its 650 predecessor, the customer base for the 650E was varied. Fleet operators, such as charter outfits, took a particular liking to the aircraft, no doubt a reflection of the airliner heritage of the 650/650E design.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR UNIT PRODUCTION												
Designation or Program	High Confidence					Good Confidence			Speculative			Total
	Thru 2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	
Embraer												
Legacy 650 <> AE 3007												
Note: Includes Legacy 650E.												
	118	1	0	0	0	0	0	0	0	0	0	1
Total	118	1	0	0	0	0	0	0	0	0	0	1