APPENDIX O.2
NATURAL RESOURCES AND ENERGY SUPPLY

The information in this appendix supports the evaluation of impacts to natural resources and energy supply provided in the Draft Environmental Impact Statement (Draft EIS), Chapter Five, *Affected Environment*, Section 5.H.4, and Chapter Six, *Environmental Consequences*, Section 6.H.4, both entitled, *Natural Resources and Energy Supply*.

The appendix includes the methodology, procedures, and assumptions used for the analysis of energy impacts at the Fort Lauderdale-Hollywood International Airport (FLL) under the Airport's Proposed Project and project alternatives (project alternatives). The basis for the analysis was the total energy consumed by the airport during the 2004 calendar year[1], and the annual number of passenger enplanements and aircraft operations for the 2005 Existing Conditions and the future analysis years. This information was used to project total energy use in future years, under each project alternative included in the Draft EIS.

O.2.1 BACKGROUND

The analysis included an assessment of the demand for utility power, defined as electricity and natural gas, and fuel demand, defined to include Jet-A fuel for jet and turboprop aircraft, low-lead aviation fuel (AvGas) for piston-engine general aviation aircraft, and diesel fuel and unleaded gasoline used to power ground access vehicles and equipment.

O.2.1.1 CONVERSION FACTORS

The use of electrical power, originally obtained in units of kilowatt hours (kWh), was converted to MBTU (million British thermal units, BTU) [2] using the following equalities:

- kWh = 3,413 BTU
- MBTU = 10^6 BTU, where 10^6 (million)

A typical heating value[3] was used to convert the volume of natural gas, given in cubic feet (ft^3), to BTU:

- 950 BTU = ft^3 natural gas

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1 Total energy use by FLL during 2004 was provided by the Broward County Aviation Department, 2005.

2 The British thermal unit (BTU) is a fundamental unit describing a unit of heat. It is defined as the heat necessary to raise the temperature of one pound of water one degree Fahrenheit at some arbitrarily chosen temperature level. Refer to Avallone, E.A. & Baumeister III, T., Eds., p. 4.3., Standard Handbook for Mechanical Engineers, 10th ed., page 4.3, 1996.

3 Lindeburg, Michael R., Engineer-in-Training Reference Manual, 8th ed., p. 30.5, 1992.

The estimate of additional fuel demands under project alternatives that require additional taxi time and delay time include the weight[4] of Jet-A and AvGas fuels, and the consumption of fuel[5] (kilograms per second, kg/s) during idle operation:

- Jet-A fuel is 6.85 pounds per gallon
- AvGas fuel is 6.00 pounds per gallon
- Average fuel consumption, jet aircraft, idle: 0.1018 kg/s
- Average fuel consumption, general aviation aircraft, idle: 0.0018 kg/s

O.2.1.2 2004 Energy Consumption and Baseline Operational Data

A summary of the 2004 energy data is provided in **Table O.2-1**, ***2004 Energy Consumption***.

Table O.2-1
2004 ENERGY CONSUMPTION
Fort Lauderdale-Hollywood International Airport

ENERGY TYPE	ANNUAL ENERGY	
Electricity	73,292,232 kWh	250,315 MBTU
Natural Gas	1,978.9 ft^3	1.88 MBTU [1]
Jet-A Fuel	111,813,609 gallons	
AvGas[2]	6,058,779 gallons	
Diesel Fuel	918,150 gallons	
Gasoline	358,242 gallons	

Note: kWh is kilowatt hours, a measure of power equal to 3,413 British thermal units (BTU).
MBTU is million British thermal units.
ft^3 is cubic feet.
BTU/ft^3 is BTU per cubic foot.

[1] Assume a heat value of 950 BTU/ft^3 for natural gas. Refer to Lindeburg, Michael R., Engineer-in-Training Reference Manual, 8th ed., p. 30.5, 1992, Belmont, CA: Professional Publications.

[2] AvGas is low-lead (100LL) aviation gasoline used in piston-engine general aviation aircraft.

Source: Broward County Aviation Department, 2005.
Landrum & Brown analysis, 2007.
Lindeburg, Michael R., Engineer-in-Training Reference Manual, 8th ed., p. 30.5, 1992.

[4] Information regarding the weight of various fuels was obtained from the internet web site: www.csgnetwork.com/fuelconsumpgphcalc.html.

[5] Fuel consumption data obtained from the FAA Emissions and Dispersion Modeling System (EDMS) database. Refer to FAA EDMS (Version 4.5), 2006.

The consumption of utility power and fuel for the 2005 Existing Conditions, and the future baseline alternatives, were projected based on the 2004 data provided in Table O.2-1 and operational information provided in Draft EIS Appendix D, *Purpose and Need*. The operational data is summarized in **Table O.2-2**, ***Baseline Enplanements and Aircraft Operations***.[6]

Table O.2-2
BASELINE ENPLANEMENTS AND AIRCRAFT OPERATIONS
Fort Lauderdale-Hollywood International Airport

YEAR	ENPLANEMENTS	AIRCRAFT OPERATIONS		
		JET OPERATIONS	GA OPERATIONS	TOTAL
2004	9,733,171	213,196	95,147	308,343
2005	10,961,895	243,632	92,478	336,111
2012	12,250,548	259,241	82,636	341,877
2020	15,412,898	313,209	95,327	408,536

Note: Jet operations used Jet A aviation fuel; GA is general aviation operations, using piston-engine aircraft powered by low-lead aviation gasoline (AvGas).

Source: Broward County Aviation Department, 2005.
Landrum & Brown analysis, 2007.

O.2.2 AIRPORT STATIONARY FACILITIES

The following subsections discuss the procedures for the analysis of the airport's total demand for electricity and natural gas. The requirement to provide power for stationary facilities focused on the passenger terminals and the airport airfield, which require electric power for cooling and lighting, and natural gas for hot water. Natural gas is consumed at a much lower rate and is used mainly to generate hot water for use in the terminals.

O.2.2.1 Electricity

The facilities that consume the bulk of electric power at the airport are the passenger terminals, which require cooling, and the airfield, which requires lighting. The project alternatives affect the demand for electricity because each alternative includes proposed expansion of the passenger terminal area along with proposed new runway and taxiway pavement that requires in-ground and low-to-the-ground lighting.

[6] Refer to Draft EIS Appendix D, *Purpose and Need*.

The airport provided data regarding the total consumption of electric power at the airport rather than subdividing the data to show the requirement for every individual facility (terminal or airfield) that contributes to the total electric power demand. The total demand for electricity under the 2005 Existing Conditions and the future 2012 and 2020 baseline was estimated by applying a factor to the 2005, 2012 and 2020 annual enplanements. The factor was the ratio of the 2004 total electric consumption to the 2004 annual enplanements. The baseline data is provided in **Table O.2-3**, ***Annual Electric Demand for Baseline Years***.

Table O.2-3
ANNUAL ELECTRIC DEMAND FOR BASELINE YEARS
Fort Lauderdale-Hollywood International Airport

ALTERNATIVE	ELECTRIC DEMAND (MBTU/year)
2005 Existing Conditions	315,056
2012 Alternative A (No Action)	396,542
2020 Alternative A (No Action)	498,905

Note: MBTU is million British thermal units per year.
Source: Landrum and Brown analysis, 2007.

Expanded Passenger Terminal Areas

Electric power for cooling at the airport is driven by the number of individuals inside the terminal buildings (enplaned passengers) and by the weather conditions. The annual number of enplanements for 2005 and each future baseline year was obtained from the aviation forecast analysis included in the Draft EIS Appendix D, *Purpose and Need*, and are provided in Table O.2-2. No estimate of the weather conditions for future years could be reasonably predicted except to note that Florida's warm southern climate requires air conditioning at the airport throughout the year.

The additional electric power needed to cool the proposed new terminal spaces under each of the project alternatives for 2012 and 2020 was projected based on the standard industry cooling ratio of 20 BTU per square foot of floor space,[7] assuming an eight-foot ceiling. The terminal spaces were assumed to extend two stories in height, so the building footprint was doubled in the calculation.

The total passenger terminal area under 2005 Existing Conditions was 734,384 square feet. The 2012 project alternatives propose the construction of new terminal space covering 747,365 square feet. The proposed expanded passenger terminal area is constant for each of the project alternatives in 2012.

Under the 2020 project alternatives, the passenger terminal space would be expanded another 246,752 square feet, for a total of 994,117 square feet of new

[7] Halpe Engineering, Northern Kentucky, (606) 431-6083, Mr. Rick Bolin.

passenger terminal space. The proposed expanded passenger terminal area is constant for each of the project alternatives in 2020.

The annual electric power required to cool the new proposed terminal area for the project alternatives was calculated assuming the cooling units operate every hour of the year, 8,760 hours, and assuming high-efficiency (80 percent) equipment. The results of the calculations are provided in **Table O.2-4**, ***Annual Electric Demand for Cooling Passenger Terminal Areas under 2012 and 2020 Project Alternatives***

Table O.2-4
ANNUAL ELECTRIC DEMAND FOR COOLING PASSENGER TERMINAL AREAS UNDER 2012 AND 2020 PROJECT ALTERNATIVES
Fort Lauderdale-Hollywood International Airport

ALTERNATIVE	ELECTRIC DEMAND (MBTU/year)
2012 Project Alternatives	220,052
2020 Project Alternatives	238,933

Note: MBTU is million British thermal units per year.
Source: Landrum and Brown analysis, 2007.

Runway and Taxiway Lighting

A portion of the demand for electricity at FLL is for airfield lighting, such as runway and taxiway edge lights, centerline lights, and the approach lighting systems at the runway thresholds. The electric energy needed to operate the lights on the runways and taxiways was calculated using the following assumptions with regard to the lighting requirements for airfield pavement:[8]

- Runways: 44 lights, 120W (watts) each, per 1,000 linear feet
- Touchdown zones (runway threshold): 376 lights, 120W each, for each runway end
- Parallel taxiways: 220 lights, 30W each, per 6,000 linear feet

The estimated new pavement that requires lights on the modified airfield, over and above what is operating under 2005 Existing Conditions, under each alternative, is summarized in **Table O.2-5**.

[8] McDonough Associates, *Concept Engineering Study*, 1995.

Table O.2-5
NEW PROPOSED RUNWAY AND TAXIWAY PAVEMENT FOR EACH PROJECT ALTERNATIVE IN 2012 AND 2020
Fort Lauderdale-Hollywood International Airport

ALTERNATIVE	NEW RUNWAY PAVEMENT	NEW RUNWAY THRESHOLD	NEW PARALLEL TAXIWAYS
Alternative B1	725	0	25,000
Alternative B1b	3,150	0	22,750
Alternative B1c	3,150	0	22,750
Alternative B4	725	0	26,700
Alternative B5	3,250	0	25,500
Alternative C1	7,721	2	14,750

Source: Landrum and Brown analysis, 2007.

The calculation of airfield lighting was further based on the estimated number of hours each year when the airfield requires the lights to be on. The annual hours were estimated to include all hours of darkness. The average sunrise in Fort Lauderdale is 6:08 a.m. and the average sunset is 6:23 p.m.,[9] and when an extra hour before sunset and one extra hour after sunrise are added, there are an average of 13.8 hours of darkness each day when the airfield lights are on, or 5,038 hours each year.

Assuming the airfield lights are also on during periods of low visibility and low cloud ceilings (referred to as Instrument Meteorological Conditions, IMC), the airfield lights are on for another 57.3 hours each year. The assumption that the lights on the modified portions of the airfield are turned on for 5,095 hours each year was included in the estimated demand for electricity for each project alternative.

Each project alternative proposes the same modifications to the airfield for both 2012 and 2020. Therefore, the increase in demand for electric power to light the modified portion of the airfield would be the same for 2012 and 2020. There is no additional power demand to light the airfield under either of the two future baseline conditions where the airfield configuration is the same as under the 2005 Existing Conditions. The data in **Table O.2-6** provides a summary of the additional electric power requirement to light the modified airfield under each of the future project alternatives.

[9] U.S. Naval Observatory, Washington, DC, Astronomical Applications Department, *Rise and Set for the Sun for 2005*, Fort Lauderdale, Forida. Data obtained from the U.S. Navy internet web site: http://aa.usno.navy.mil/cgi-bin/aa_rstablew.pl.

Table O.2-6
ADDITIONAL ELECTRIC POWER DEMAND TO LIGHT THE MODIFIED PORTIONS OF THE AIRFIELD UNDER EACH PROJECT ALTERNATIVES
Fort Lauderdale-Hollywood International Airport

ALTERNATIVE	ELECTRIC POWER DEMAND (MBTU/year)
Alternative B1	1,329
Alternative B1b	1,509
Alternative B1c	1,509
Alternative B4	577
Alternative B5	788
Alternative C1	2,560
Alternative D1	3,285 (2020 only)
Alternative D2	3,138 (2020 only)

Note: MBTU is million British thermal units.
Source: Landrum and Brown analysis, 2007.

O.2.2.2 Natural Gas

Typically, various gaseous fuels can be used as energy sources, but most applications at airports are limited to natural gas and liquefied petroleum gases. *Natural gas* is a mixture of methane (55 percent-95 percent), higher hydrocarbons (primarily ethane), and noncombustible gases. Typical heating values of natural gas range from 950 to 1100 BTU per cubic foot.[10] The amount of natural gas required to heat water in the terminal areas was assumed to be dependent on the number of enplanements. As described for electric power, forecasts of annual enplanements provide a reasonable estimate of the number of persons utilizing the terminals.

Therefore, the future demand for natural gas was based on the ratio of the 2004 annual enplanements to the 2004 total natural gas consumption. The ratio was applied to the annual enplanements for 2005, 2012, and 2020. Using this methodology, the natural gas demand for 2005 Existing Conditions and the future baseline years was projected as given in **Table O.2-7**. The additional natural gas energy required to heat water for the new proposed terminal spaces for the project alternatives was projected based on the proposed new passenger terminal areas, as described for the electric energy demand. The additional natural gas demand under the project alternatives is included in Table O.2-7.

[10] Lindeburg, Michael R., Engineer-in-Training Reference Manual, 8th ed., p. 30.5, 1992, Belmont, CA: Professional Publications.

Table O.2-7
ANNUAL NATURAL GAS DEMAND FOR BASELINE YEARS AND PROJECT ALTERNATIVES
Fort Lauderdale-Hollywood International Airport

ALTERNATIVE	NATURAL GAS DEMAND (MBTU/year)
2005 Existing Conditions	2.37
2012 Alternative A (No Action)	2.98
2012 Project Alternatives	Additional 0.22
2020 Alternative A (No Action)	3.75
2020 Project Alternatives	Additional 2.75

Note: MBTU is million British thermal units per year.
Source: Landrum and Brown analysis, 2007.

O.2.3 AIRCRAFT OPERATIONS

The demand for fuel to support aircraft operations includes the requirement for aviation fuel for jets (Jet A), low-lead aviation gasoline (AvGas) for piston-engine general aviation aircraft, diesel fuel for ground support equipment (GSE), and unleaded gasoline for GSE and other airport access vehicles. The total requirement for fuel to support aircraft operations was assumed to be proportional to the annual number of annual operations. A factor was applied to the annual operations of jet aircraft in 2005, 2012, and 2020 to estimate the demand for Jet-A fuel. The factor was the 2004 consumption of Jet-A fuel to the 2004 number of annual jet-aircraft operations. To estimate the demand for AvGas, the same methodology was used by considering general aviation aircraft operations. The total fuel demand was projected as provided in **Table O.2-8, *Annual Fuel Demand for Baseline Years***.

Table O.2-8
ANNUAL FUEL DEMAND FOR BASELINE YEARS
Fort Lauderdale-Hollywood International Airport

ALTERNATIVE	FUEL DEMAND BY TYPE			
	JET A (million gallons)	**AVGAS** (million gallons)	**DIESEL** (million gallons)	**GASOLINE** (million gallons)
2005 Existing Conditions	127.8	5.9	1.0	0.39
2012 Alternative A (No Action)	160.3	5.1	1.1	0.43
2020 Alternative A (No Action)	203.2	6.0	1.3	0.52

Note: Jet A is fuel for jet aircraft; AvGas is low-lead gasoline for piston-engine aircraft.
Source: Landrum and Brown analysis, 2007.

The demand for diesel fuel and unleaded gasoline was assumed to remain constant for all the project alternatives under 2012 and 2020 conditions. This is because the number of annual operations, which influences the use of GSE and airport access vehicles, would remain constant for all the project alternatives.

However, the demand for Jet-A fuel and AvGaS would be affected by the changes in taxi time and aircraft departure queue delay time with each baseline condition and project alternative, for each future year. The net increase in taxi time and delay time calculated for each project alternative is provided in **Table O.2-9**.

The additional fuel required under each project alternative to account for the different taxi time and delay times provided in Table O.2-9 was calculated with respect to the number of annual jet and general aircraft operations, and the average fuel consumption of jet and general aviation aircraft operating in idle mode. The estimated increase in fuel demand is provided in **Table O.2-10**.

Table O.2-9
ADDITIONAL TAXI AND DELAY TIME FOR THE BASELINE AND PROJECT ALTERNATIVES
Fort Lauderdale-Hollywood International Airport

ALTERNATIVE	TAXI AND DELAY TIME (minutes)
2012 ALTERNATIVES	
Alternative A	9.6
Alternative B1	2.7
Alternative B1b	2.2
Alternative B1c	4.9
Alternative B4	1.2
Alternative B5	2.6
Alternative C1	8.0
2020 ALTERNATIVES	
Alternative A	25.1
Alternative B1	4.6
Alternative B1b	4.1
Alternative B1c	4.1
Alternative B4	3.7
Alternative B5	4.5
Alternative C1	11.1
Alternative D1	9.4
Alternative D2	7.6

Note: Jet A is fuel for jet aircraft; AvGas is low-lead gasoline for piston-engine aircraft.
Source: Landrum and Brown analysis, 2007.

O.2.4 SUMMARY

The total demand for electricity under the 2012 and 2020 project alternatives is the sum of the baseline demand (reflects the increase in passenger enplanements), plus the additional demand to cool the proposed new passenger terminal areas, plus the electric power required to light the new airfield pavement.

Table O.2-10
ADDITIONAL ANNUAL FUEL DEMAND FOR BASELINES AND PROJECT ALTERNATIVES
Fort Lauderdale-Hollywood International Airport

ALTERNATIVE	FUEL DEMAND BY TYPE	
	JET A (million gallons)	AVGAS (gallons)
2012 ALTERNATIVES		
Alternative A	4.9	0.031
Alternative B1	1.4	0.009
Alternative B1b	1.1	0.007
Alternative B1c	2.5	0.016
Alternative B4	0.6	0.004
Alternative B5	1.3	0.008
Alternative C1	4.1	0.026
2020 ALTERNATIVES		
Alternative A	15.5	0.094
Alternative B1	2.8	0.017
Alternative B1b	2.5	0.015
Alternative B1c	2.5	0.015
Alternative B4	2.3	0.014
Alternative B5	2.7	0.017
Alternative C1	6.8	0.041
Alternative D1	5.8	0.035
Alternative D2	4.7	0.029

Note: Jet A is fuel for jet aircraft; AvGas is low-lead gasoline for piston-engine aircraft.
Source: Landrum and Brown analysis, 2007.

The total demand for natural gas under the 2012 and 2020 project alternatives is the sum of the baseline demand (reflects the increase in passenger enplanements), plus the additional demand to heat water in the proposed new terminal areas.

The total demand for Jet-A fuel under the 2012 and 2020 project alternatives is the sum of the baseline demand (reflects the increase in jet aircraft operations) and the additional fuel required for the net increase in average taxi and delay time for jet aircraft under the project alternatives.

The total demand for AvGas under the 2012 and 2020 project alternatives is the sum of the baseline demand (reflects the increase in general aviation aircraft operations) and the additional fuel required for the net increase in average taxi and delay time for general aviation aircraft under the project alternatives.

The total demand for diesel fuel and unleaded gasoline under the 2012 and 2020 project alternatives reflects the increase in total aircraft operations. None of the project alternatives would affect the consumption of diesel fuel or unleaded gasoline.

U.S. Department
of Transportation
Federal Aviation Administration

Orlando Airports District Office
5950 Hazeltine National Dr., Suite 400
Orlando, FL 32822-5024

Phone: 407-812-6331

January 12, 2007

Florida, Power, and Light
P.O. Box 025576
Miami, FL 33102

RE: **For Lauderdale-Hollywood International Airport**
Environmental Impact Statement

Dear:

The Federal Aviation Administration (FAA) is preparing an Environmental Impact Statement (EIS) to assess the potential environmental impacts that may result from improvements proposed for the Fort Lauderdale-Hollywood International Airport (FLL). The Airport Sponsor's Proposed Project includes the redevelopment and extension of Runway 27L and elevation of Runway 9R/27L to provide adequate clearance over the Florida East Coast (FEC) Railway. The project would also include construction of additional taxiways requiring navigational lighting, the installation of an instrument landing lighting system, the closure of Runway 13/31, and relocation of the Airport Surveillance Radar (ASR), a computer-supported navigational aid. Additional elements of the project include the construction of additional passenger terminal spaces, the closure of the Wyndham Fort Lauderdale Airport Hotel, displacement of the Jet Center facilities, and the full displacement of the Gulfstream Airways aircraft maintenance facilities. Implementation of the project would affect the demand for electric and natural gas power, which would require the FAA to include in the EIS an evaluation of the potential increased demand for electrical and natural gas energy due to the Airport Sponsor's Proposed Project and the project alternatives.

The expected increase in the demand for electric power would include energy required to cool the proposed passenger terminal spaces and displaced ancillary buildings such as the Jet Center and Gulfstream Airways maintenance facilities, and light the proposed airfield. The FAA estimates that the demand from any of the project alternatives would not be greater than 610,000 MBTU of electricity per year in 2012 based on the size of the proposed buildings and the size of the airfield modifications. The 2005 baseline year usage was approximately 250,315 MBTU of electrical power per year, a value based on the review of monthly statements received from Florida Power and Light (FPL).

Pursuant to FAA Order 1050.1E, *Environmental Impacts: Policies and Procedures*, the FAA is required to contact the airport's energy suppliers to determine if projected demands can be met by the power company's existing or planned facilities. We would appreciate your determination with regard to the ability of FPL to meet the projected additional energy demand at FLL.

Please do not hesitate to contact me if you have any questions regarding this submission or the EIS process, I can be reached at (407) 812-6331 extension 129.

Virginia Lane, AICP
Environmental Specialist
Orlando Airports District Office

U.S. Department
of Transportation
Federal Aviation Administration

Orlando Airports District Office
5950 Hazeltine National Dr., Suite 400
Orlando, FL 32822-5024

Phone: 407-812-6331

January 12, 2007

TECO Peoples Gas
702 North Franklin Street
P.O. Box 2562
Tampa, Florida 33601-2562

RE: **For Lauderdale-Hollywood International Airport**
Environmental Impact Statement

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The expected increase in the demand for natural gas would include energy required to support the proposed passenger terminal spaces and displaced ancillary buildings such as the Jet Center and Gulfstream Airways maintenance facilities. The FAA estimates that the increase in demand from any of the alternatives would not be greater than 4.00 MBTU of natural gas per year in 2012 based on the size of the proposed buildings. The 2005 baseline year usage was approximately 1.88 MBTU of natural gas per year, a value based on the review of monthly statements received from Peoples Gas.

Pursuant to FAA Order 1050.1E, *Environmental Impacts: Policies and Procedures*, the FAA is required to contact the airport's energy suppliers to determine if projected demands can be met by the power company's existing or planned facilities. We would appreciate your determination with regard to the ability of Peoples Gas to meet the projected additional energy demand at FLL.

Please do not hesitate to contact me if you have any questions regarding this submission or the EIS process, I can be reached at (407) 812-6331 extension 129.

Virginia Lane, AICP
Environmental Specialist
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