



# ACRP 09-10 BENCHMARKING AND PROFILING AIRPORT TERMINAL ENERGY END USES

Prepared for  
*Airport Cooperative Research Program (ACRP)*  
TRANSPORTATION RESEARCH BOARD  
OF THE NATIONAL ACADEMIES

By



**ENERGY SYSTEMS LABORATORY**  
TEXAS A&M ENGINEERING EXPERIMENT STATION



**Energy  
Commissioning  
Group**

## **TRB Project Team**

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# **Energy Systems Laboratory The Texas A&M University System**

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Marshall Hussain

# Objectives

**(1) create initial energy use intensity (EUI) benchmarks by gathering data to measure, estimate, or model energy end uses in airport passenger terminals, and**

**(2) develop EUI profiles for energy end uses for several representative airport terminals.**

**One of the final products of this project is a tool for developing EUI profiles of airport terminals that can assist airports in managing their energy usage.**

## **What's the need for Benchmarking Study for Airport Terminal Buildings?**

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**To have a global reference of the energy consumption in an Airport Terminal Building (ATB).**

**It can be referenced to enplanements, or**

**It can be referenced to conditioned/gross area**

## **What's the need for Benchmarking Study for Airport Terminal Buildings?**

### **Considerations**

**Size of the airport terminal building(FAA-ACAIS 2013):**

**Small (<1.5 millions annual enplanements),**

**Medium (>1.5 and 8.0<) and**

**Large (>8.0)**

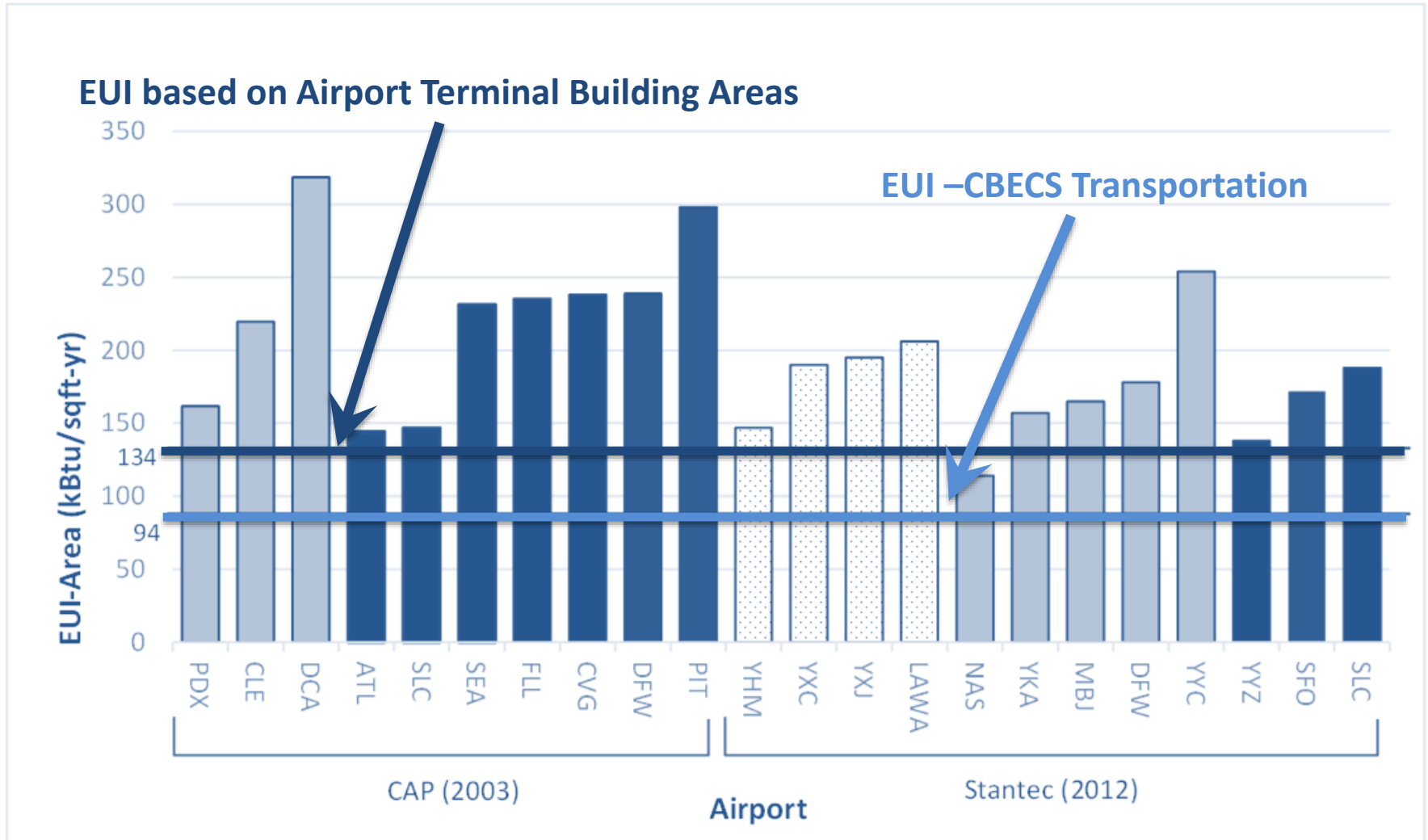
**Location:**

**Climatic Zones: Cold(6), Moderate(3,4,5) and  
Warm(2)**

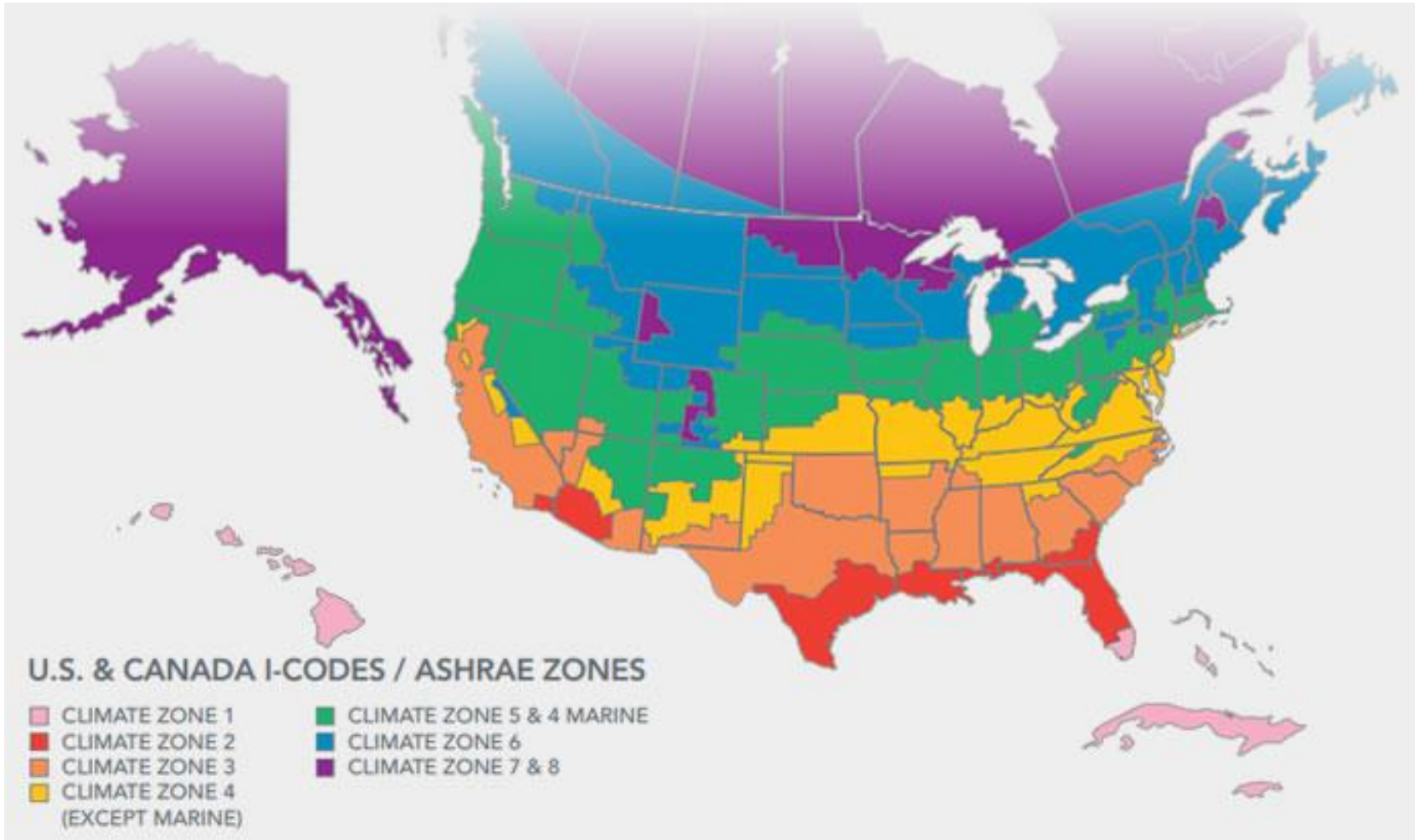
**Data Source:**

**Commercial Building Energy Consumption Survey  
EPA's ENERGY STAR portafolio manager, etc**

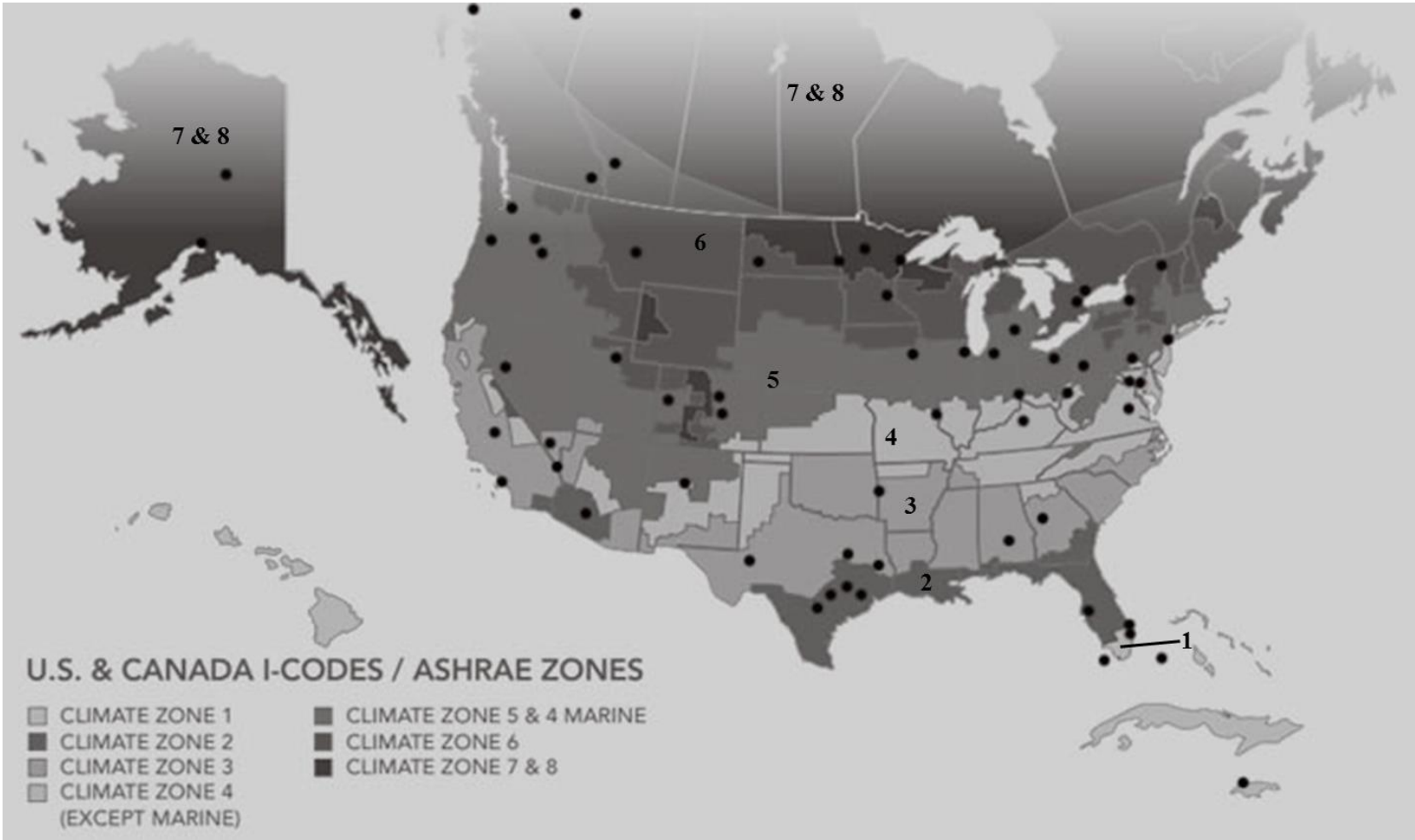
# What's the need for Benchmarking Study for Airport Terminal Buildings?



## Participating Sample of Airport Terminal Buildings (ATBs)

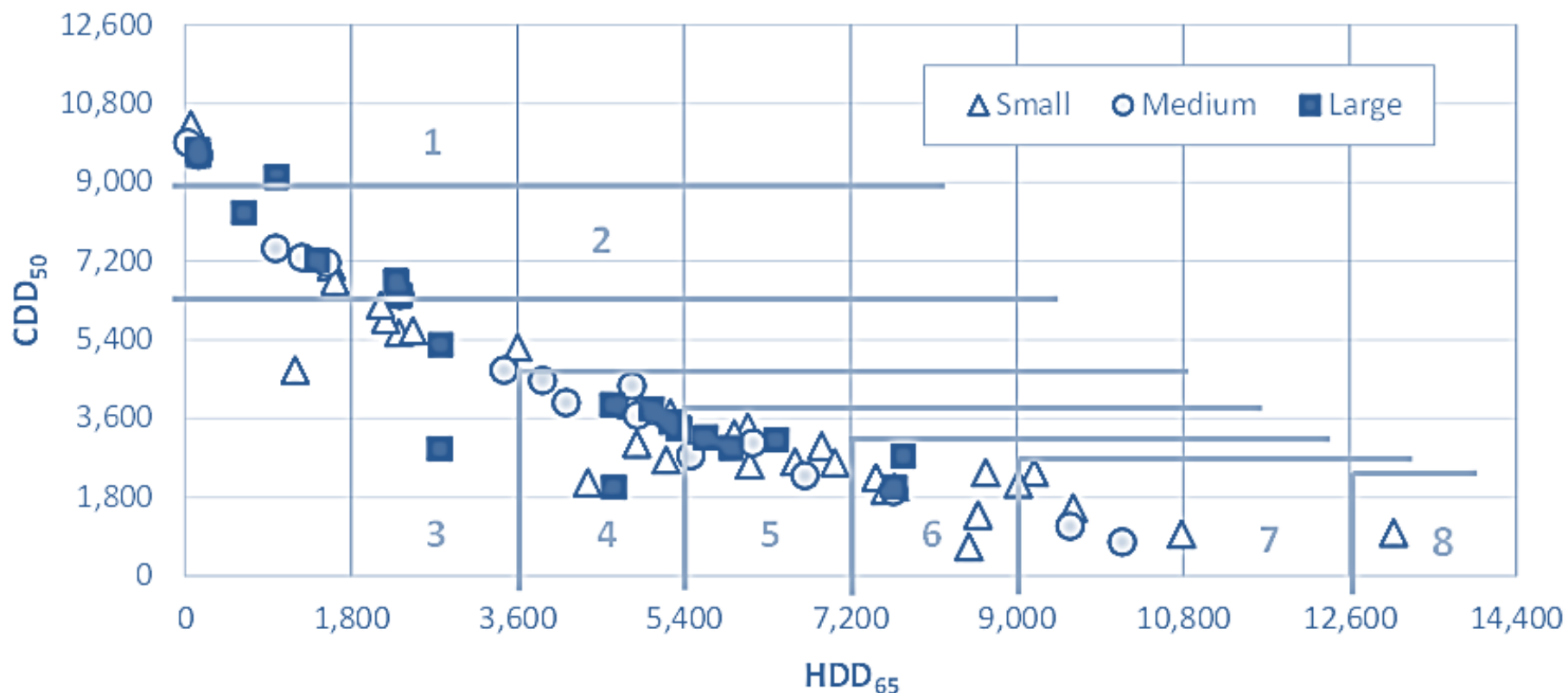


## Participating Sample of Airport Terminal Buildings (ATBs)

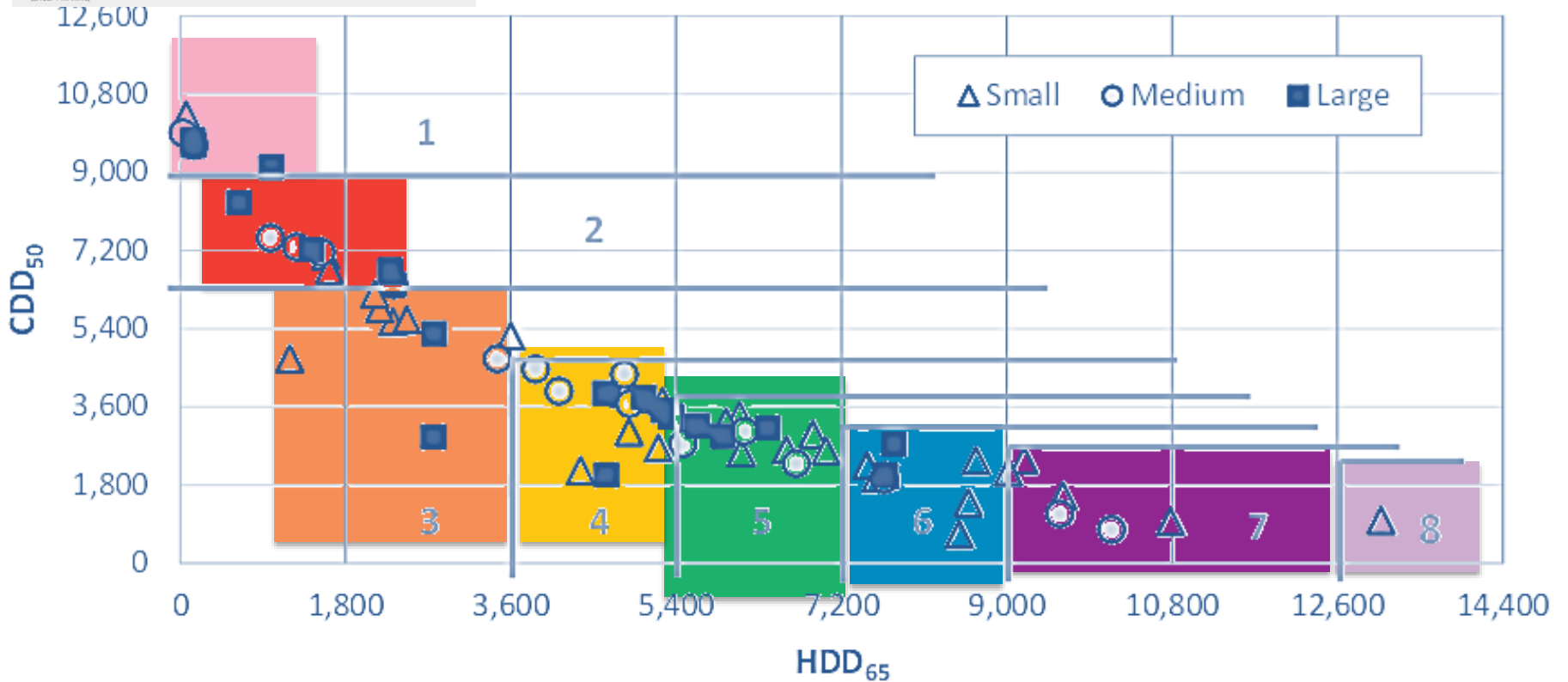
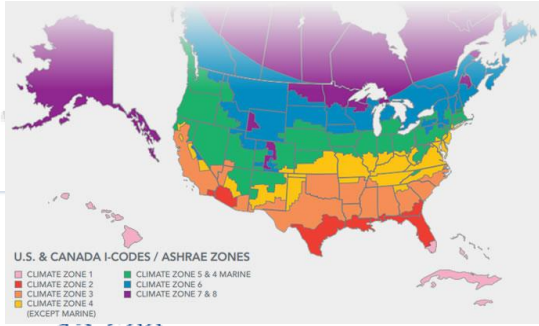




## Participating Sample of Airport Terminal Buildings (ATBs)



# Participating Sample of Airport Terminal Buildings (ATBs)

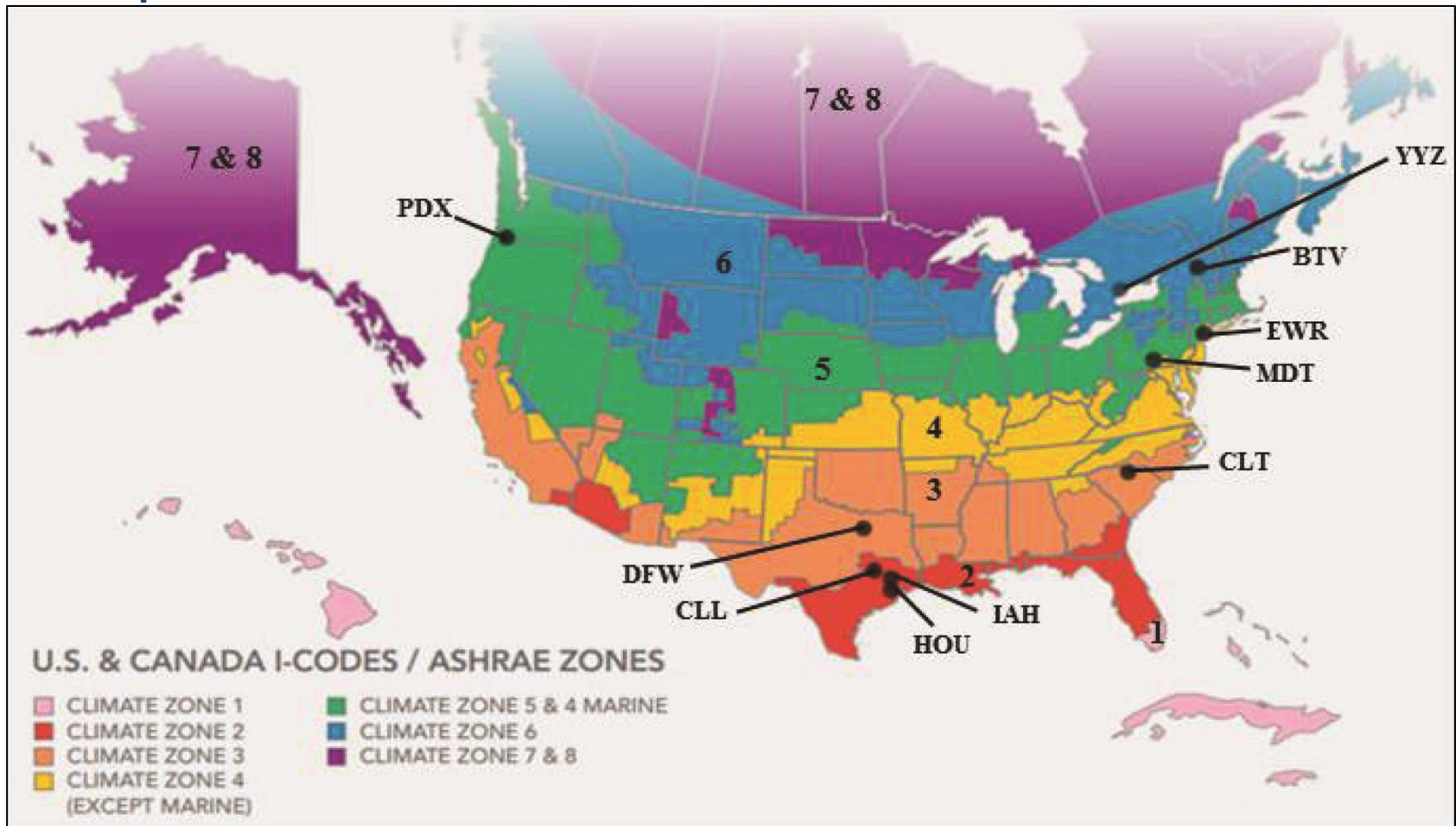


## Participating Sample of Airport Terminal Buildings (ATBs)

Airport Name	Code	City	State/ Province	Airport Size	Climate Zone
George Bush Int'ctl Airport	IAH	Houston	TX	L	2
William P. Hobby Airport	HOU	Houston	TX	M	2
Easterwood Airport	CLL	College Station	TX	Nonhub	2
Charlotte Douglas International Airport	CLT	Charlotte	NC	L	3
Dallas/Fort Worth International Airport	DFW	Dallas/Fort Worth	TX	L	3
Newark Liberty International Airport	EWR	Newark	NJ	L	4
Portland International Airport	PDX	Portland	OR	M	4
Harrisburg International Airport	MDT	Middletown	PA	S	5
Toronto Pearson International Airport	YYZ	Mississauga	Ontario- Canada	L	6
Burlington International Airport	BTV	Burlington	VT	S	6

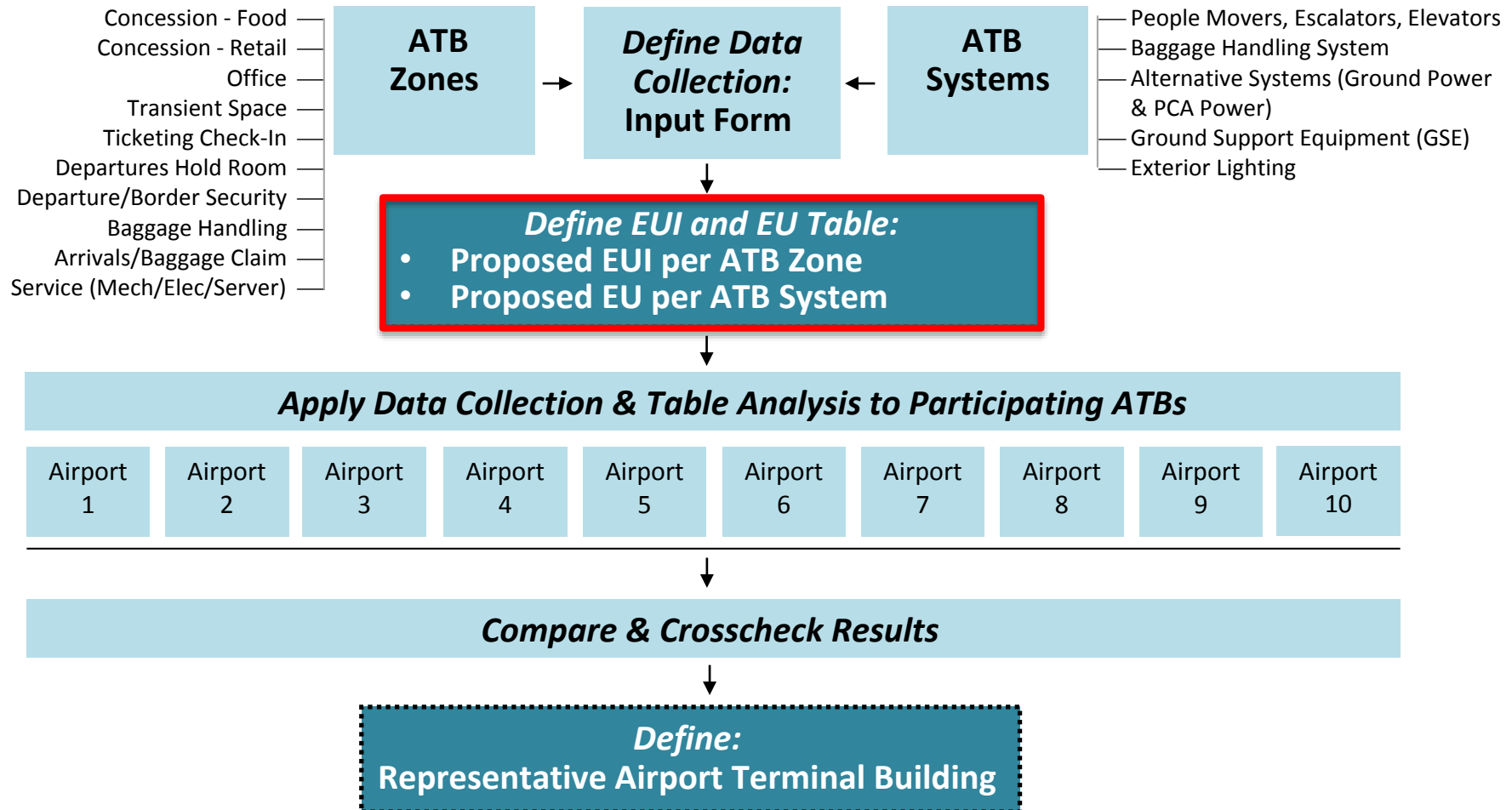
## Participating Sample of Airport Terminal Buildings (ATBs)

The Participating Airports Identified on U.S & Canada I-Codes / ASHRAE Climate Zones Map



# The Process of Data Collection & Analysis

## The Process of Data Analysis & Development of EUI Benchmarks



# The Process of Data Collection & Analysis

## Define EUI and EU Table

$$EUI_{ATB, total} \text{ (kBtu/sqft-yr)} = \boxed{EUI_{all\ ATB\ Zones, total} \text{ (kBtu/sqft-yr)}} + EU_{all-systems, total} \text{ (kBtu/yr)} / \text{Terminal Gross Area (sqft)}$$

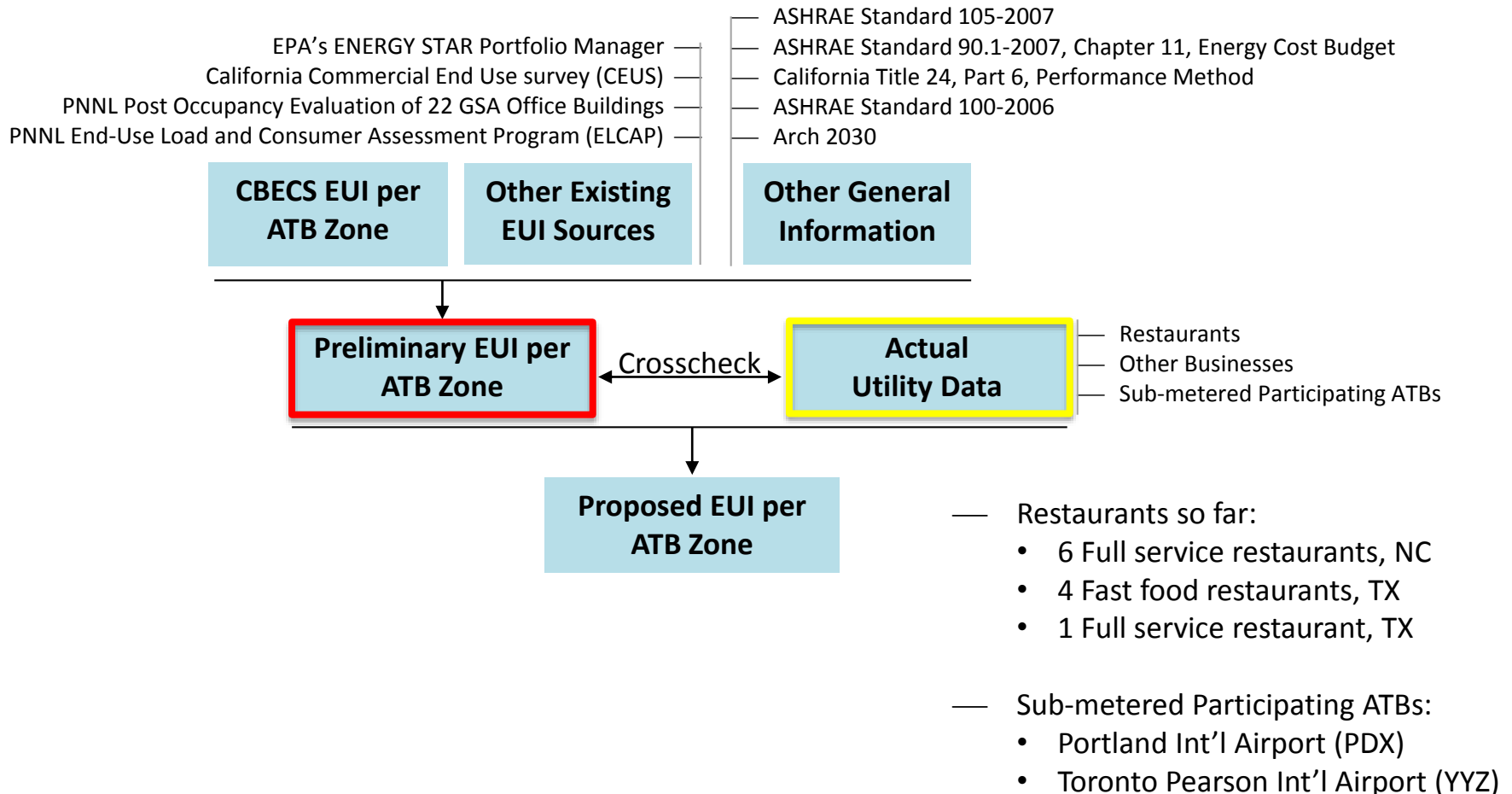
## ATB EUI Table

		Terminal Gross Area (sq.ft.):			
Airport Terminal Building (ATB) Zones / Systems		Proposed EUI per Zone (kBtu/sqft- yr)	Floor Area (sqft)	Energy Use (kBtu/yr)	Total Energy Use Index (kBtu/sqft- yr)
ATB Zones	1	Concession - Food			
	2	Concession - Retail			
	3	Office			
	4	Transient Space			
	5	Ticketing Check-In			
	6	Departures Hold Room			
	7	Departure/Border Security			
	8	Outbound/Inbound Baggage Handling			
	9	Arrivals/Baggage Claim			
	10	Service (Mech/Elec/Server)			
<b>Subtotal for all ATB Zones</b>					
ATB Systems	11	People Movers, Escalators, Elevators			
	12	Baggage Handling Systems			
	13	Alternative Systems (Ground Power & PCA Power)			
	14	Airport Ground Support Equipment (GSE) Electricity Use			
	15	External Lighting, Parking Lighting			
<b>Subtotal for all ATB Systems</b>					
<b>Total for ATB Zones &amp; Systems</b>					
<b>Total for ATB based on Utility Bills</b>					

# The Process of Data Collection & Analysis

*Define EUI and EU Table*

## Defining Proposed EUI per Airport Terminal Building Zone



# The Process of Data Collection & Analysis

*Define EUI and EU Table*

## Comparison of EUIs for Building Types from Different Sources per ATB Zone

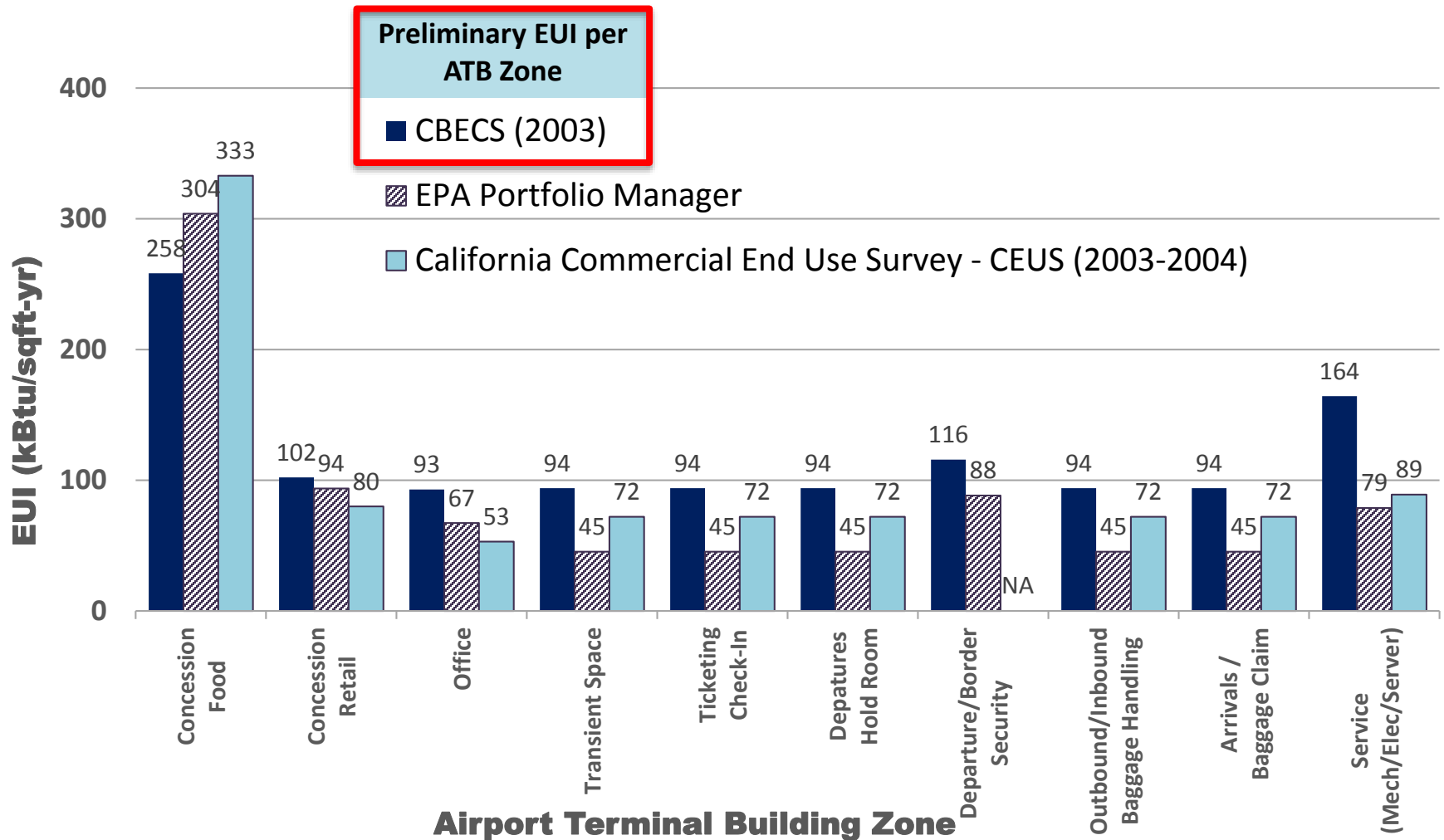
No	Airport Terminal Building Zone	CBECS Data (2003)		EPA Portfolio Manager (Using 2003 CBECS Data)		California Commercial End Use Survey - CEUS (2008)	
		Building Type	Mean EUI (kBtu/ft <sup>2</sup> -yr)	Building Type	Median EUI (kBtu/ft <sup>2</sup> -yr)	Building Type	Median EUI (kBtu/ft <sup>2</sup> -yr)
1	Concession Food	Food Service	258	Food Sales & Service - Fast Food Restaurant & Restaurant	304	Food Services - Restaurant	333
2	Concession Retail	Enclosed Mall	102	Retail - Enclosed Mall	94	Enclosed shopping Center - Mall	80
3	Office	Office	93	Office - Office	67	Office - Professional	53
4	Transient Space	Public Assembly	94	Public Services - Transportation Terminal/Station	45	Public Assembly	72
5	Ticketing Check-In	Public Assembly	94	Public Services - Transportation Terminal/ Station	45	Public Assembly	72
6	Departures Hold Room	Public Assembly	94	Public Services - Transportation Terminal/Station	45	Public Assembly	72
7	Departure/Bor der Security	Public Order & Safety	116	Public Services - Police Station	88	NA	NA
8	Outbound/Inb ound Baggage Handling	Public Assembly	94	Public Services - Transportation Terminal/Station	45	Public Assembly	72
9	Arrivals / Baggage Claim	Public Assembly	94	Public Services - Transportation Terminal/Station	45	Public Assembly	72
10	Service (Mech/Elec/Server)	Other	164	Other - Utility (CBECS - Other)	79	Other - Unknown	89



# The Process of Data Collection & Analysis

Define EUI and EU Table

## EUIs Comparison between Different Sources



# The Process of Data Collection & Analysis

*Define EUI and EU Table*

$$EUI_{ATB, total} \text{ (kBtu/sqft-yr)} = \boxed{EUI_{all\ ATB\ Zones, total} \text{ (kBtu/sqft-yr)}} + EU_{all-systems, total} \text{ (kBtu/yr)} / \text{Terminal Gross Area (sqft)}$$

## ATB EUI Table

		Terminal Gross Area (sq.ft.):			
Airport Terminal Building (ATB) Zones / Systems		Proposed EUI per Zone (kBtu/sqft- yr)	Floor Area (sqft)	Energy Use (kBtu/yr)	Total Energy Use Index (kBtu/sqft- yr)
ATB Zones	1	Concession - Food	258.3		
	2	Concession - Retail	73.9		
	3	Office	92.9		
	4	Transient Space	93.9		
	5	Ticketing Check-In	93.9		
	6	Departures Hold Room	93.9		
	7	Departure/Border Security	115.8		
	8	Outbound/Inbound Baggage Handling	93.9		
	9	Arrivals/Baggage Claim	93.9		
	10	Service (Mech/Elec/Server)	164.4		
<b>Subtotal for all ATB Zones</b>					
ATB Systems	11	People Movers, Escalators, Elevators			
	12	Baggage Handling Systems			
	13	Alternative Systems (Ground Power & PCA Power)			
	14	Airport Ground Support Equipment (GSE) Electricity Use			
	15	External Lighting, Parking Lighting			
<b>Subtotal for all ATB Systems</b>					
<b>Total for ATB Zones &amp; Systems</b>					
<b>Total for ATB based on Utility Bills</b>					

# The Process of Data Collection & Analysis

## Define EUI and EU Table

$$EUI_{ATB, total} \text{ (kBtu/sqft-yr)} = EUI_{all\ ATB\ Zones, total} \text{ (kBtu/sqft-yr)} + EU_{all-systems, total} \text{ (kBtu/yr)} / \text{Terminal Gross Area (sqft)}$$

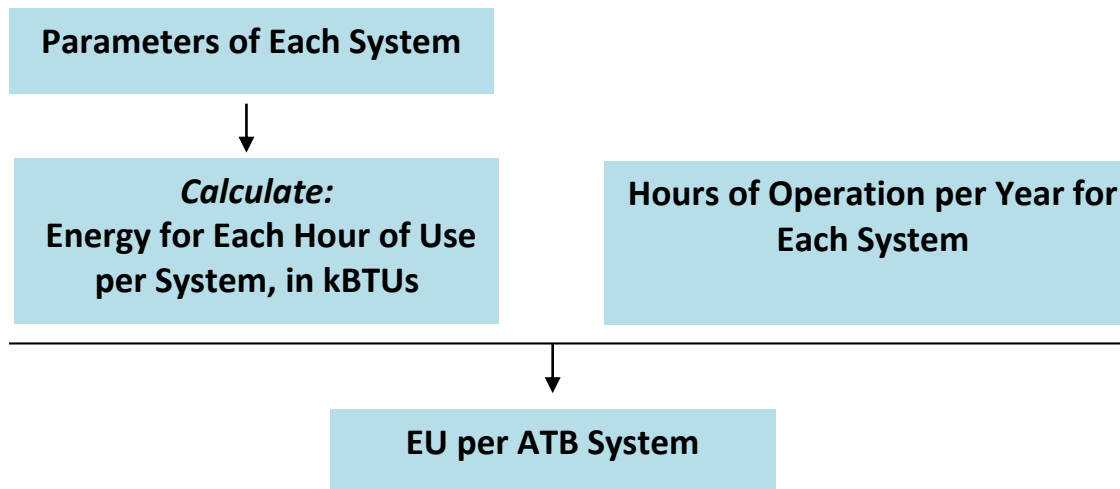
## ATB EUI Table

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	15	External Lighting, Parking Lighting				
<b>Subtotal for all ATB Systems</b>						
<b>Total for ATB Zones &amp; Systems</b>						
<b>Total for ATB based on Utility Bills</b>						

# The Process of Data Collection & Analysis

## Define EUI and EU Table

### Defining EU per Airport Terminal Building System

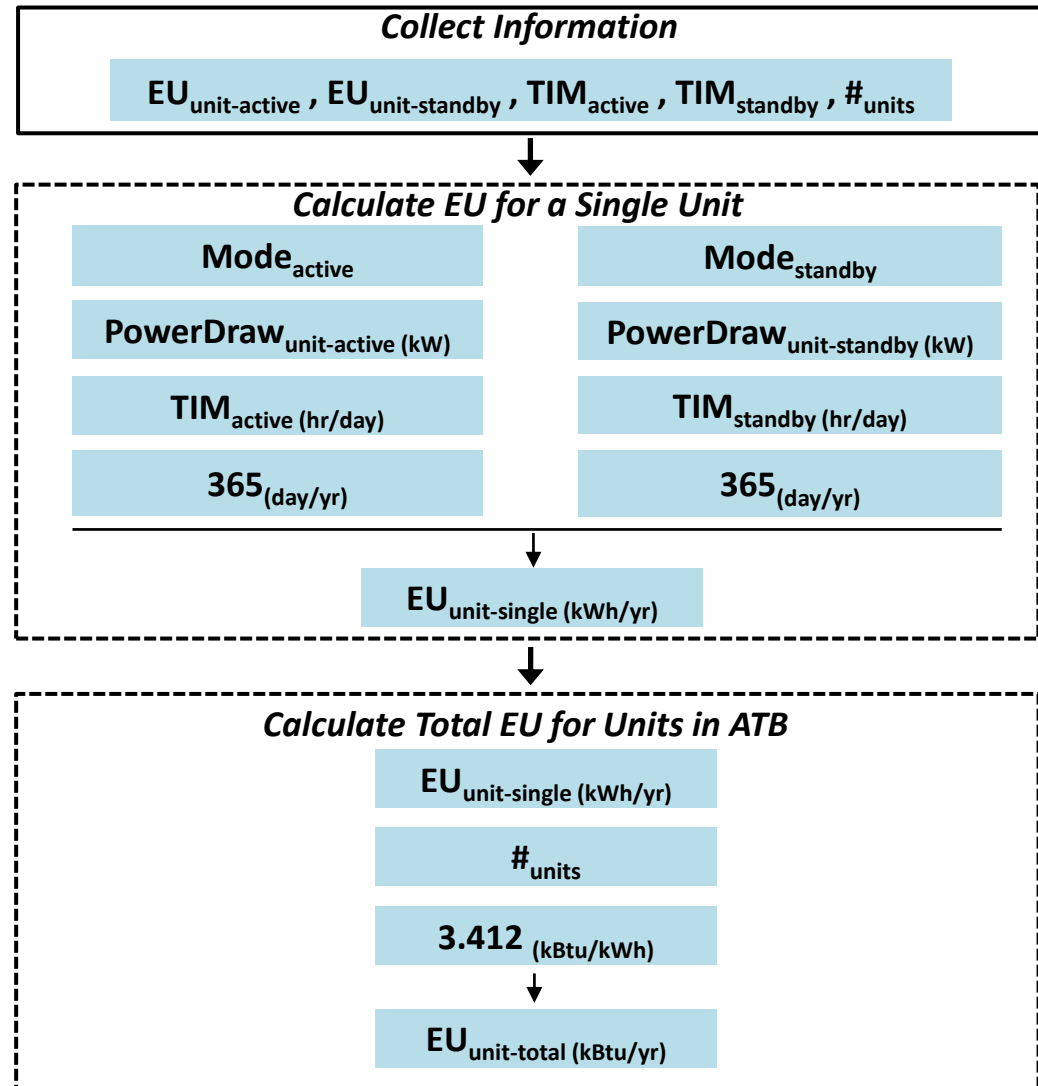


$$\begin{aligned}
 EU_{\text{all-systems, total}} = & EU_{\text{escalator-total}} + EU_{\text{people-mover-total}} \\
 & + EU_{\text{baggage handling-total}} + EU_{\text{elevator-total}} \\
 & + EU_{\text{alternative systems-total}} + EU_{\text{ground support equipment-total}} \\
 & + EU_{\text{exterior lighting}} \\
 & + EU_{\text{other}}
 \end{aligned}$$

# The Process of Data Collection & Analysis

## Define EUI and EU Table

Calculating Total Annual EU for Escalators, People Movers (Moving Walkways), and Baggage Handling Systems in ATB



# The Process of Data Collection & Analysis

*Define EUI and EU Table*

## Calculating Total Annual EU for Escalators in the ATB

$$EU_{\text{escalator-total}} = \{(EU_{\text{escalator-active}} \times TIM_{\text{active}} \times 365) + (EU_{\text{escalator-standby}} \times TIM_{\text{standby}} \times 365)\} \times \#_{\text{units}} \times 3.412$$

Where:

$EU_{\text{escalator-total}}$  = Annual electricity use of all units in the ATB (kBtu/yr),

$EU_{\text{escalator-active}}$  = Power Draw per Unit in mode; active (kW),

$TIM_{\text{active}}$  = Time in mode; active (hr/day),

$EU_{\text{escalator-standby}}$  = Power Draw per Unit in mode; standby (kW),

$TIM_{\text{standby}}$  = Time in mode; standby (hr/day),

$\#_{\text{units}}$  = Number of Escalators in Airport Terminal Building.

1 kWh = 3.412 kBtu

# The Process of Data Collection & Analysis

*Define EUI and EU Table*

## Calculating Total Annual EU for People Movers in the ATB

$$\begin{aligned}
 \text{EU}_{\text{people mover-total}} = & \{(\text{EU}_{\text{people mover-active}} \times \text{TIM}_{\text{active}} \times 365) \\
 & + (\text{EU}_{\text{people mover-standby}} \times \text{TIM}_{\text{standby}} \times 365)\} \\
 & \times \#_{\text{units}} \times 3.412
 \end{aligned}$$

Where:

$\text{EU}_{\text{people mover-total}}$  = Annual electricity use of all units in the ATB (kBtu/yr),

$\text{EU}_{\text{people mover-active}}$  = Power Draw per Unit in mode; active (kW),

$\text{TIM}_{\text{active}}$  = Time in mode; active (hr/day),

$\text{EU}_{\text{people mover-standby}}$  = Power Draw per Unit in mode; standby (kW),

$\text{TIM}_{\text{standby}}$  = Time in mode; standby (hr/day),

$\#_{\text{units}}$  = Number of Units in Airport Terminal Building.

1 kWh = 3.412 kBtu

# The Process of Data Collection & Analysis

*Define EUI and EU Table*

## Calculating Total Annual EU for Baggage Handling Systems in the ATB

$$\begin{aligned} \text{EU}_{\text{baggage handling-total}} = & \{ (\text{EU}_{\text{baggage handling-active}} \times \text{TIM}_{\text{active}} \times 365) \\ & + (\text{EU}_{\text{baggage handling-standby}} \times \text{TIM}_{\text{standby}} \times 365) \} \\ & \times \#_{\text{units}} \times 3.412 \end{aligned}$$

Where:

$\text{EU}_{\text{baggage handling-total}}$  = Annual electricity use of all units in the ATB (kBtu/yr),

$\text{EU}_{\text{baggage handling-active}}$  = Power Draw per Unit in mode; active (kW),

$\text{TIM}_{\text{active}}$  = Time in mode; active (hr/day),

$\text{EU}_{\text{baggage handling-standby}}$  = Power Draw per Unit in mode; standby (kW),

$\text{TIM}_{\text{standby}}$  = Time in mode; standby (hr/day),

$\#_{\text{units}}$  = Number of Units in Airport Terminal Building.

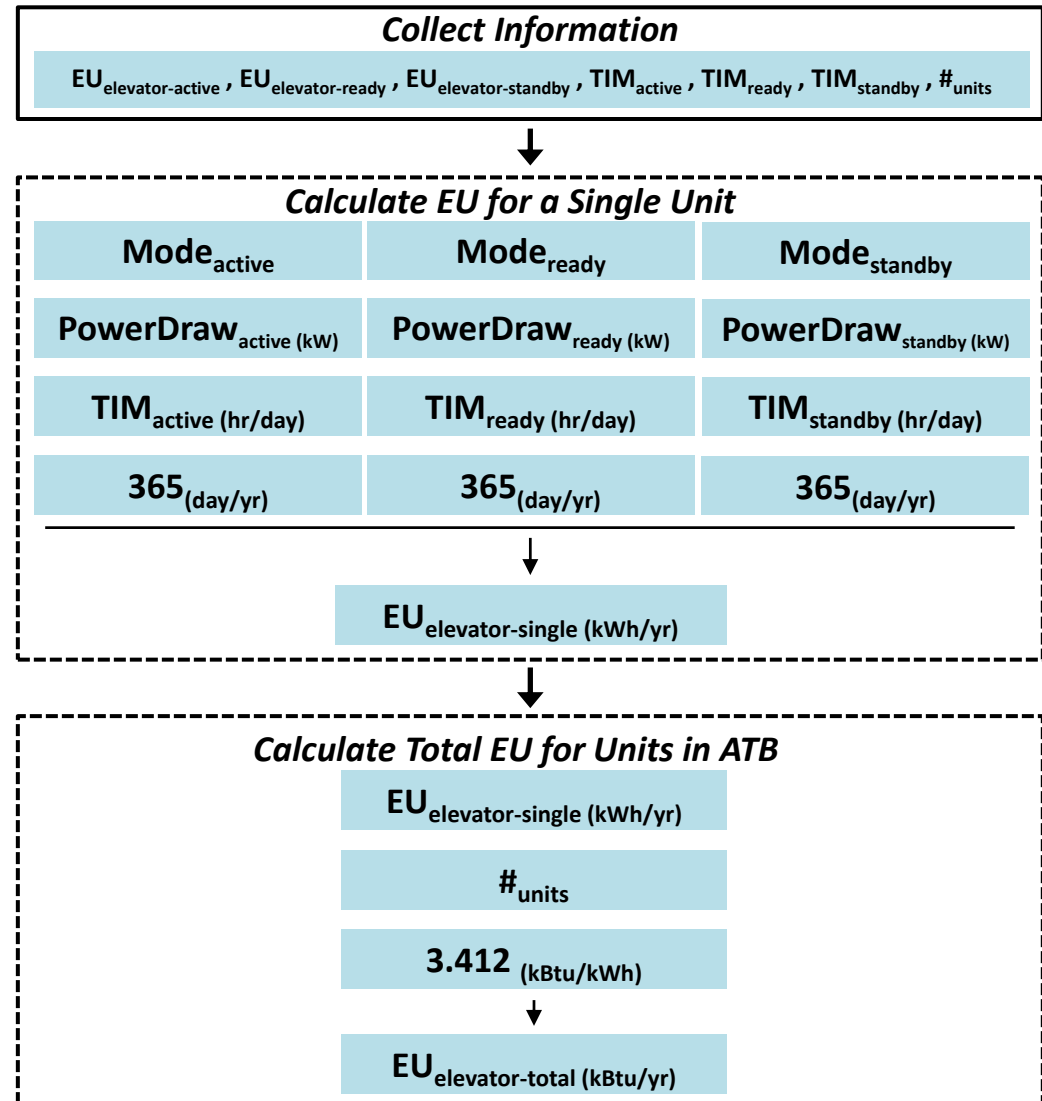
1 kWh = 3.412 kBtu



# The Process of Data Collection & Analysis

Define EUI and EU Table

## Calculating Total Annual EU for Elevators in ATB



# The Process of Data Collection & Analysis

## Define EUI and EU Table

### Calculating Total Annual EU for Elevators in ATB

$$\text{EU}_{\text{elevator-total}} = \{(\text{EU}_{\text{elevator-active}} \times \text{TIM}_{\text{active}} \times 365) + (\text{EU}_{\text{elevator-ready}} \times \text{TIM}_{\text{ready}} \times 365) + (\text{EU}_{\text{elevator-standby}} \times \text{TIM}_{\text{standby}} \times 365)\} \times \#_{\text{units}} \times 3.412$$

Where:

$\text{EU}_{\text{elevator-total}}$  = Annual electrical energy use of all elevators in the ATB (kBtu/yr),

$\text{EU}_{\text{elevator-active}}$  = Power Draw per Unit in mode; active (kW),

$\text{TIM}_{\text{active}}$  = Time in mode; active (hr/day),

$\text{EU}_{\text{elevator-ready}}$  = Power Draw per Unit in mode; ready (kW),

$\text{TIM}_{\text{ready}}$  = Time in mode; ready (hr/day),

$\text{EU}_{\text{elevator-standby}}$  = Power Draw per Unit in mode; standby (kW),

$\text{TIM}_{\text{standby}}$  = Time in mode; standby (hr/day),

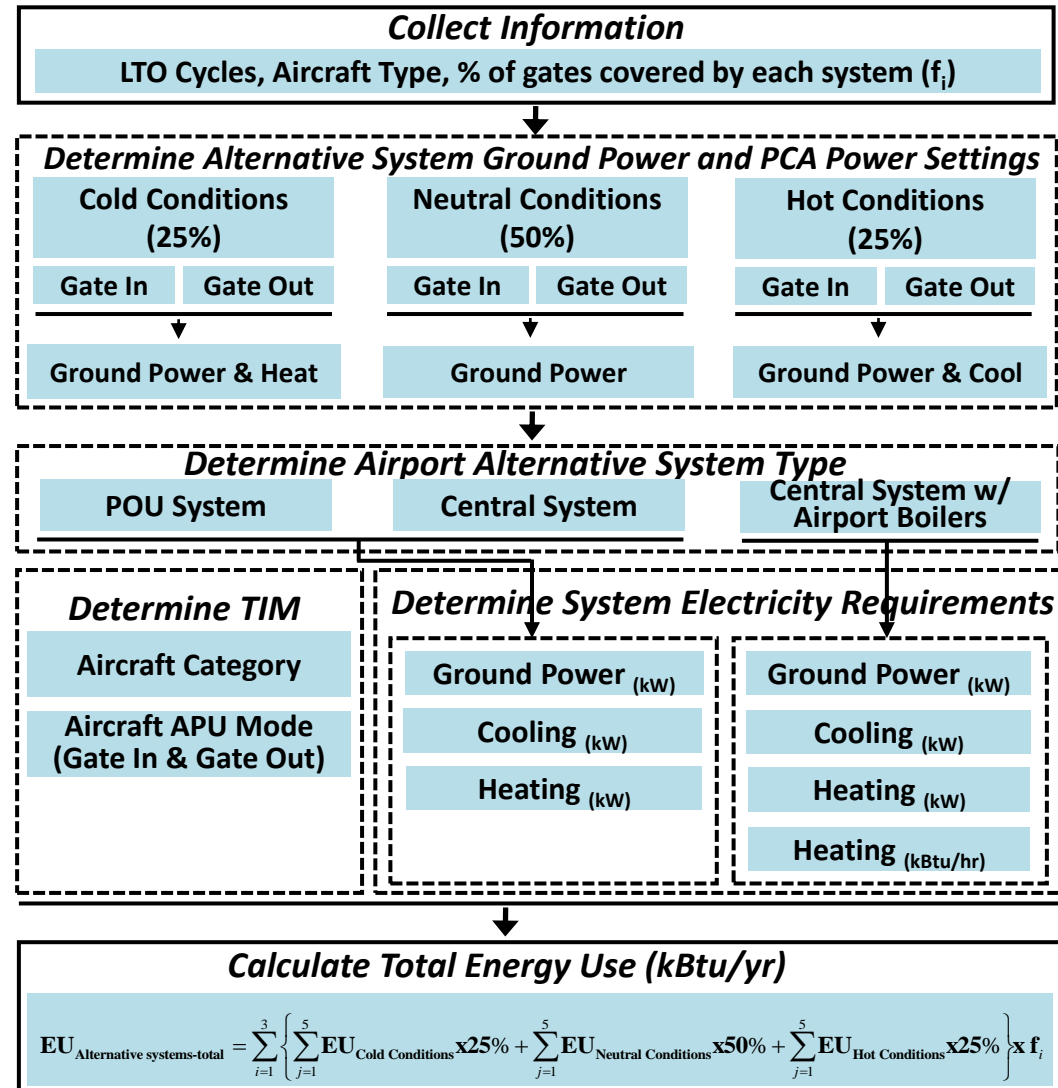
$\#_{\text{units}}$  = Number of elevator Units in the ATB.

1 kWh = 3.412 kBtu

# The Process of Data Collection & Analysis

*Define EUI and EU Table*

## Calculating Total Annual EU of Alternative Systems in ATB



# The Process of Data Collection & Analysis

*Define EUI and EU Table*

## Calculating Total Annual EU of Alternative Systems in ATB

$$EU_{\text{Alternative systems-total}} = \sum_{i=1}^3 \left\{ \sum_{j=1}^5 EU_{\text{Cold Conditions}} \times 25\% + \sum_{j=1}^5 EU_{\text{Neutral Conditions}} \times 50\% + \sum_{j=1}^5 EU_{\text{Hot Conditions}} \times 25\% \right\} \times f_i$$

Where:

$EU_{\text{Alternative systems-total}}$  = Annual electrical EU of all Alternative System units in the ATB (kBtu/yr),

$EU_{\text{Cold Conditions}}$  =  $EU_{\text{ground power}}$  +  $EU_{\text{heating}}$ ,

$EU_{\text{Neutral Conditions}}$  =  $EU_{\text{ground power}}$ ,

$EU_{\text{Hot Conditions}}$  =  $EU_{\text{ground power}}$  +  $EU_{\text{cooling}}$ ,

$i = 1, 2, 3$ , representing three alternative system types, including POU system, Central system, and Central system with Airport Boilers,

$j = 1, 2, 3, 4, 5$ , representing up to five aircraft types, including narrow body, wide body, jumbo-wide body, regional jet, and turbo prop,

$f_i$  = Percentage of gates using this system to deliver ground power, heating and cooling.

$$EU_{\text{Alternative systems-total}} = \sum_{i=1}^3 \left\{ \sum_{j=1}^5 EU_{\text{ground power}} + \sum_{j=1}^5 EU_{\text{heating}} \times 25\% + \sum_{j=1}^5 EU_{\text{cooling}} \times 25\% \right\} \times f_i$$

# The Process of Data Collection & Analysis

*Define EUI and EU Table*

## Calculating Total Annual EU of Ground Support Equipment (GSE) in ATB

$$EU_{\text{Ground Support Equipment}} = \sum_{k=1}^N (GS \times TIM_{\text{active}} + EU_{\text{Standby}} \times TIM_{\text{standby}}) \times 365 \times 3.412$$

Where:

$EU_{\text{Ground Support Equipment}}$  = Annual energy use of the ground support equipment (kBtu/yr),

$GS$  = Ground Support power (kW),

$TIM_{\text{active}}$  = Time in mode, active (hr/day),

$EU_{\text{Standby}}$  = Electric power in standby mode (kW),

$TIM_{\text{standby}}$  = Time in mode, standby (hr/day),

$k=1,2,\dots,N$ , representing  $N$  types of ground support equipment.

# The Process of Data Collection & Analysis

## *Define EUI and EU Table*

### Calculating Total Annual EU of Exterior Lighting

$$EU_{\text{exterior lighting}} = EU_{\text{exposed lighting}} + EU_{\text{covered lighting}}$$

Where:

$$EU_{\text{exposed lighting}} \text{ (kBtu)} = (\text{LPD}/1000) \times A \text{ ft}^2 \times 12 \text{ hr/day} \times 365 \text{ day/yr} \times 3.412 \text{ kBtu/kWh}$$

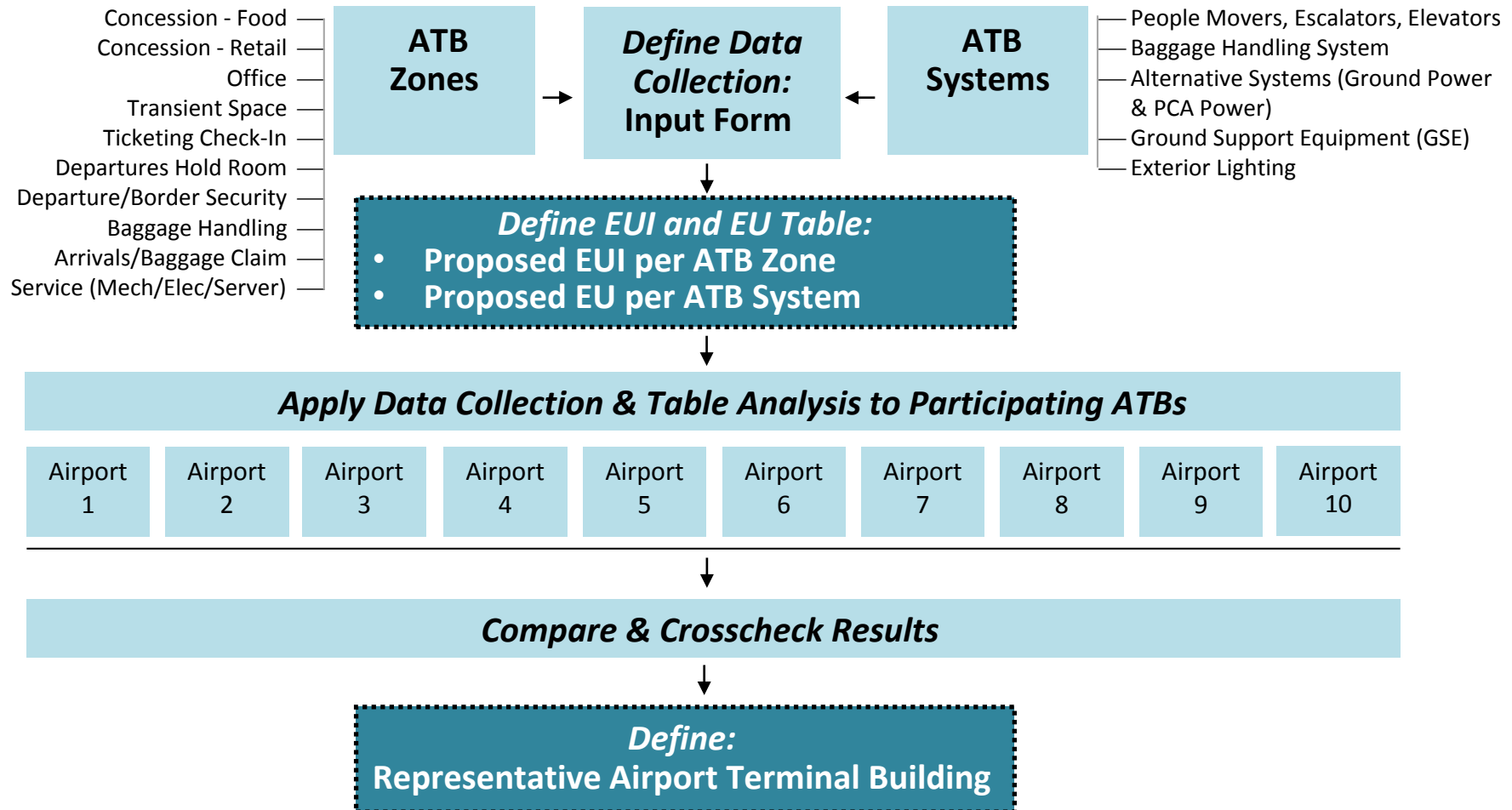
$$EU_{\text{covered lighting}} \text{ (kBtu)} = (\text{LPD}/1000) \times A \text{ ft}^2 \times 24 \text{ hr/day} \times 365 \text{ day/yr} \times 3.412 \text{ kBtu/kWh}$$

Where:

LPD = Lighting Power Density ( $\text{W}/\text{ft}^2$ ),  
A= Area illuminated ( $\text{ft}^2$ ).

# The Process of Data Collection & Analysis

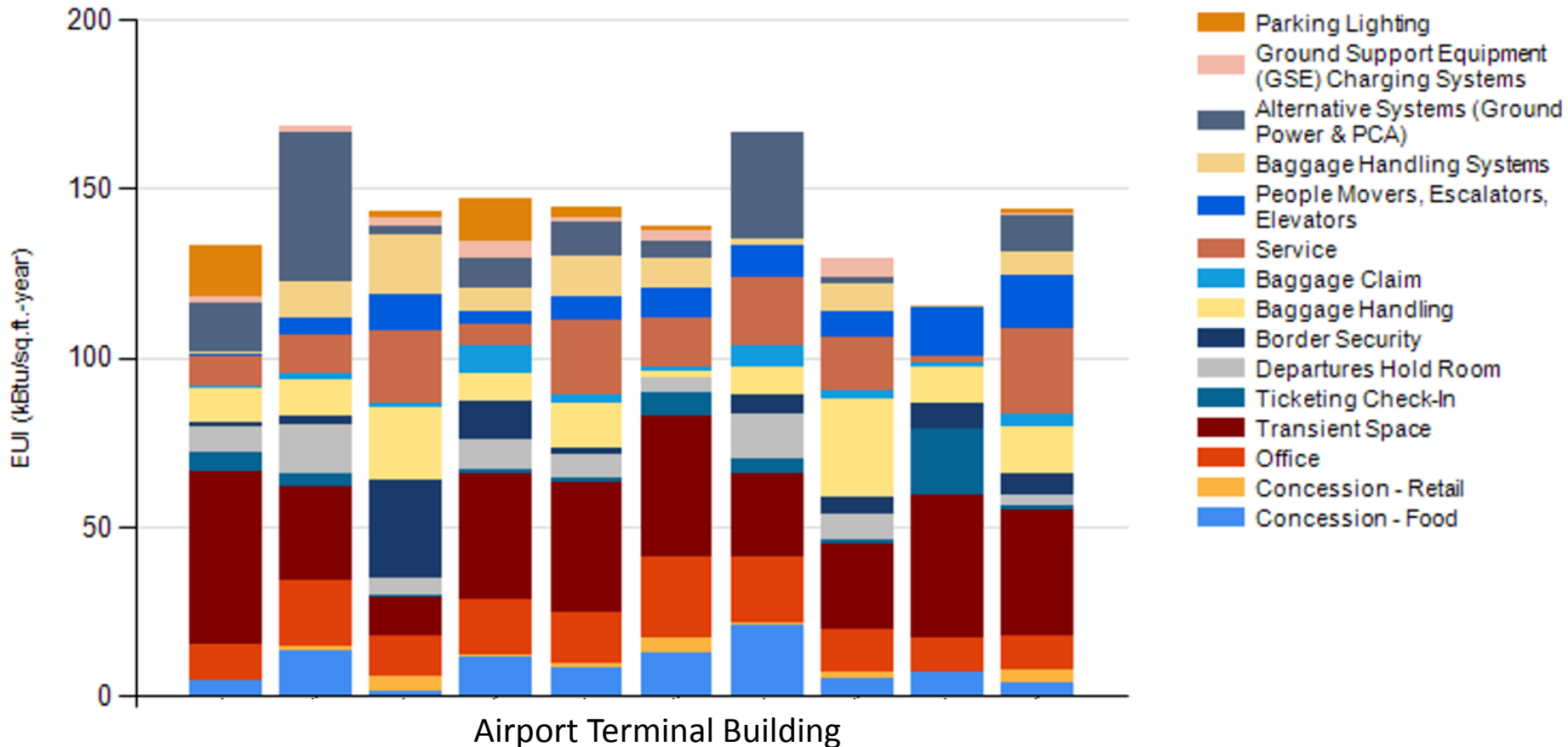
## The Process of Data Analysis & Development of EUI Benchmarks



# The Process of Data Collection & Analysis

Compare & Crosscheck Results

## ATB Zones EUI across Participating ATBs

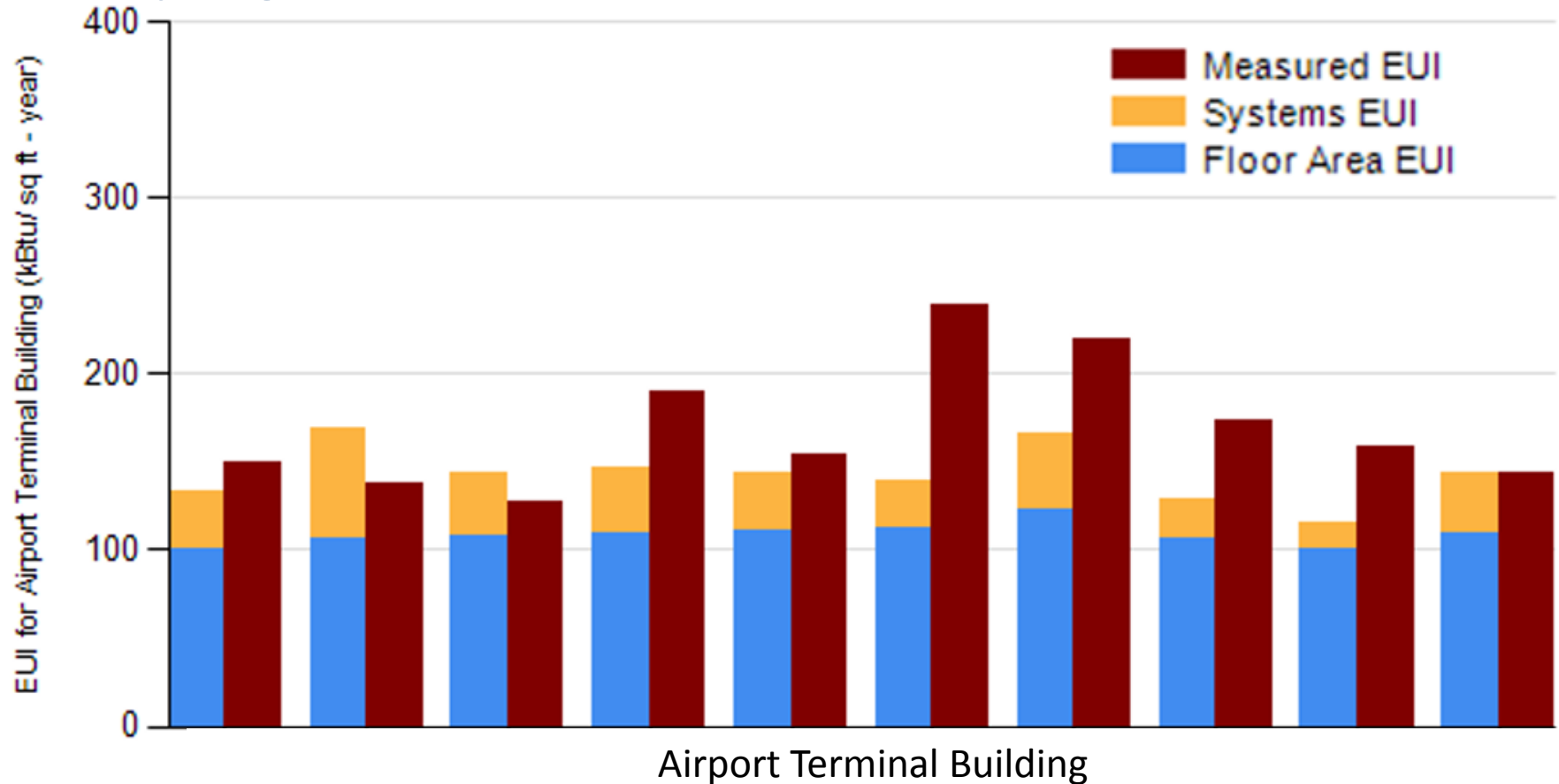




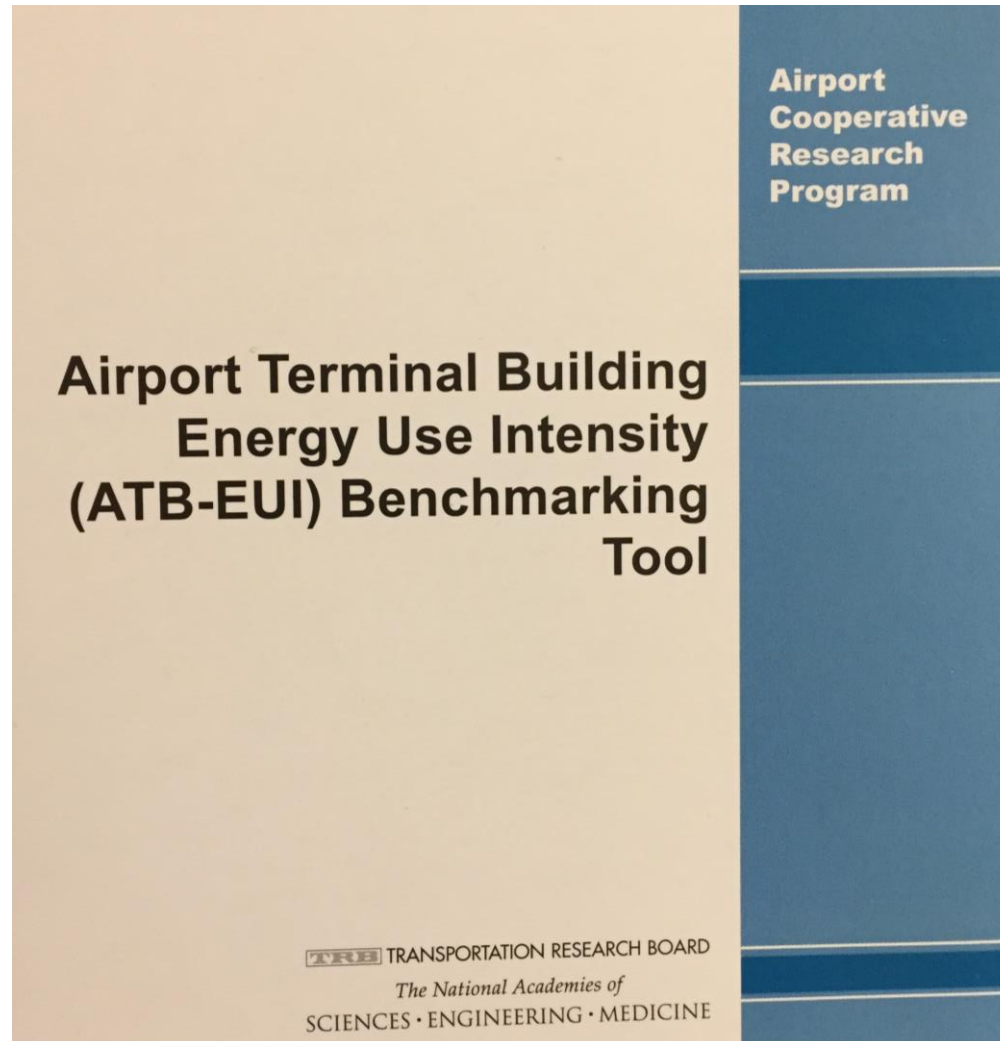
# The Process of Data Collection & Analysis

*Compare & Crosscheck Results*

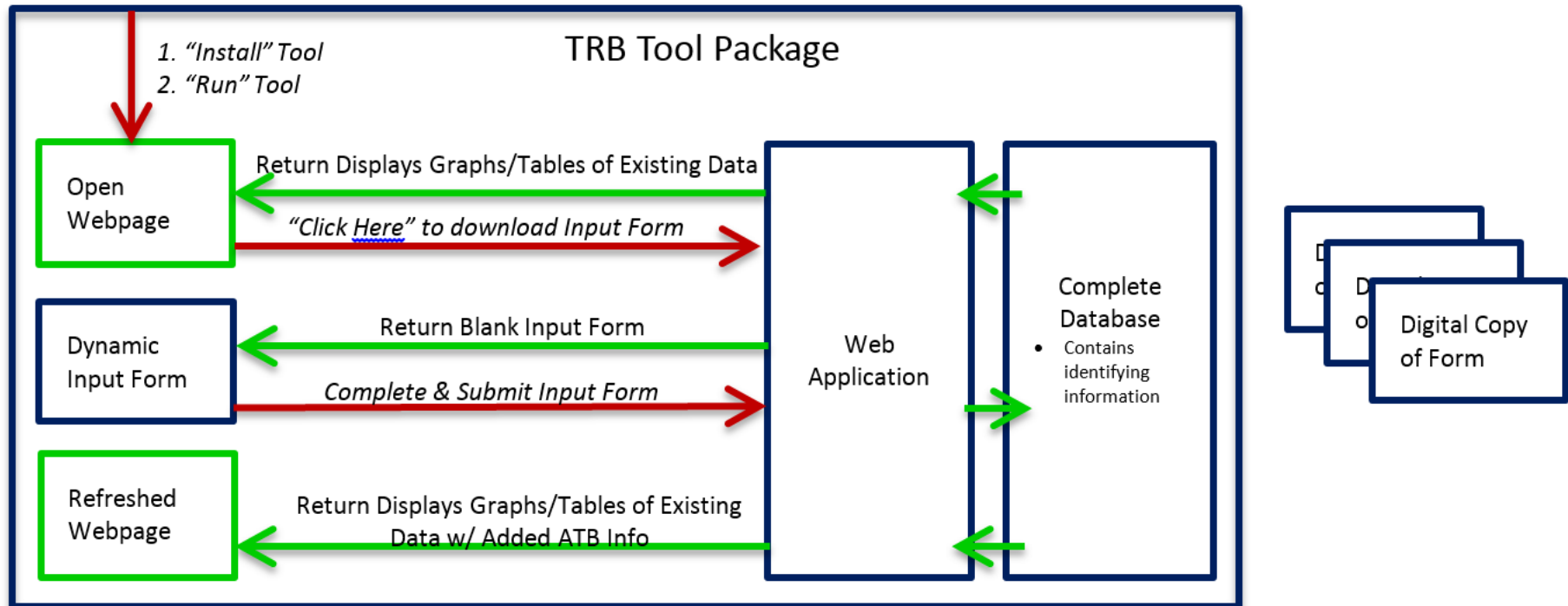
Total EUI for the ATB based on Utility Bills & Subtotal EUI for all ATB Zones across Participating ATBs



# Benchmarking Tool



## Prototype System Diagram



# Input Form



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**TERMINAL ENERGY USE INDICES BE**  
(Version 20)

*Any information provided by the party*

Date of Survey: \_\_\_/\_\_\_/\_\_\_ Airport Name: \_\_\_\_\_

**Contact Information**

Name: \_\_\_\_\_  
Title: \_\_\_\_\_  
Phone number: \_\_\_\_\_  
Email: \_\_\_\_\_

**Airport Terminal Building - General Information**

Terminal name: \_\_\_\_\_  
Terminal construction year: \_\_\_\_\_  
Terminal renovation year: \_\_\_\_\_  
No. of gates: \_\_\_\_\_  
No. of floors: \_\_\_\_\_  
Operating Hours: Weekdays: \_\_\_\_\_ a.m. to \_\_\_\_\_  
Weekends: \_\_\_\_\_ a.m. to \_\_\_\_\_  
Holidays: \_\_\_\_\_ a.m. to \_\_\_\_\_

**Airport Terminal Building – Floor Space Information**

The following table provides 10 zone categories.

- (a) Please complete the "Total Airport Terminal Building Floor Area" column of the table.
- (b) Please complete the floor area breakdown per Airport Terminal Building "Floor Area (%)" column of the table.

**Airport Terminal Building Conditions**

No.	Airport Terminal Zones	Floor Area (ft <sup>2</sup> )
1	Concession - Food	
2	Concession - Retail	
3	Office	
4	Transient Space	
5	Ticketing Check-in	
6	Departure Hold Room	
7	Departure/Border Security	
8	Outbound/Inbound Baggage Handling	
9	Arrivals/Baggage Claim	
10	Service (Mech/Elec/Server)	
<b>Total Airport Terminal Building Floor Area</b>		



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**Airport Terminal Building - Mechanical Systems**

Please complete the following tables on the mechanical systems.

**Airport Terminal Building - Baggage**

Type	Model No.	Manufacturer
1		
2		
3		
4		
5		

**Airport Terminal Building - PEO**

Type	Model No.	Manufacturer
1		
2		
3		
4		
5		

**Airport Terminal Building**

Type	Model No.	Manufacturer
1		
2		
3		
4		
5		

**Airport Terminal Building**

Type	Model No.	Manufacturer
1		
2		
3		
4		
5		

**Airport Terminal Building - Airport Ground Support**

Please complete the following table on the GSE that exist.

**Airport Terminal Building**

GSE Type	Model No.	Manufacturer
De-icing Cart		
Ramping Cart		
Jet Engine Air start Cart		
Aircraft Tie		
Portable Ground Power		
Other:		



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**Airport Terminal Building – Alternative Systems (Group)**

(a) Please provide the number of Landing and Takeoff (LTO) per year. For aircraft categories, please refer to Table 1. *Evolving Emissions and Costs of APUs and Alternatives*

- Narrow Body, No. of LTO cycles per year: \_\_\_\_\_
- Wide Body, No. of LTO cycles per year: \_\_\_\_\_
- Jumbo-Wide Body, No. of LTO cycles per year: \_\_\_\_\_
- Regional Jet, No. of LTO cycles per year: \_\_\_\_\_
- Turbo Prop, No. of LTO cycles per year: \_\_\_\_\_

Table 1. Aircraft types and auxiliary power units group

Aircraft Category	Example Aircraft Types
Narrow Body	Boeing 737-700 Series, Boeing MD-80 Series, Airbus A320 Series, Boeing 757-200 Series, Airbus A319-100 Series, Boeing 737-800 Series, Boeing 737-300 Series, Boeing 717-200 Series, Embraer ERJ170, Embraer ERJ175.
Wide Body	Boeing 767-300 Series, Boeing 777-200 Series, Airbus A300B/C/F-600 Series, Boeing 767-200 Series, Boeing 767-400, Airbus A31200 Series, Boeing 777-300 Series, Airbus A300B/C/F Series, Airbus A310-300 Series, Boeing 787-300 Series.
Jumbo - Wide Body	Boeing 747-400 Series, Airbus A330-200 Series, Airbus A340-200 Series, Boeing 747-200/300 Series, Airbus A330-300 Series, Airbus A340-600 Series, Airbus A340-300 Series, Airbus A340-500 Series, Boeing 747-100 Series, Airbus A380 Series.
Regional Jet	Bombardier CRJ-200/400, Embraer ERJ145, Bombardier CRJ-700, Bombardier CRJ-900, Embraer ERJ140, Bombardier CRJ-100, Embraer ERJ135, Dornier 328 Jet, BAE 146-100, BAE 146-200.
Turbo Prop	DeHavilland DHC-8-400, DeHavilland DHC-8-100, Embraer EMB120 Brasilia, DeHavilland DHC-8-300, DeHavilland DHC-8-200, Shorts 360-100 Series, DeHavilland DHC-7 Dash 7, Embraer EMB 110 Bandeirante, Fokker F27-100 Series, Fokker F27-200 Series.

SOURCE: Developed from the FAA's Emissions and Dispersion Modeling System

(b) Please complete the following, indicating the percent use the specified alternative system types.

- \_\_\_\_\_ % of gates - have Point of Use (POU) System
- \_\_\_\_\_ % of gates - have Central System.
- \_\_\_\_\_ % of gates - have Central System with Air



ACRP 09-10

ID:

(Please do not fill out this area)

**Airport Terminal Building - External Lighting / Parking Lighting**

Is energy consumption of external lighting/parking lighting included in the airport terminal building utility bill?  
 Yes  No

If "Yes", please provide the following information:  Covered illuminated area (ft<sup>2</sup>): \_\_\_\_\_  
 None-covered illuminated area (ft<sup>2</sup>): \_\_\_\_\_  
(i.e., open to the sky)

**Airport Terminal Building - Performance and Utilities Information**

Please provide 12-month metered utility data if available for the airport terminal building. If monthly utility information is not available, please provide the Total Annual energy use.

**Airport Terminal Building – Utility Information**  
For the Period: \_\_\_\_\_ (m/d/year - m/d/year)

	Date of Utility Bill (m/d/year-m/d/year)	Electricity (kWh/month)	Natural Gas (Units: <input type="checkbox"/> CCF <input type="checkbox"/> DMCF <input type="checkbox"/> Therms)	Other: _____ (Units: _____)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
<b>Total Annual</b>				

Is monthly sub-metered utility data available for the airport terminal building?  
 Yes  No

If "Yes", please check all that apply:  
 Electricity  Natural gas  Other (please specify): \_\_\_\_\_

# Input Form

Date of Survey: \_\_\_/\_\_\_/\_\_\_ Airport Name: \_\_\_\_\_ Airport Code: \_\_\_\_\_

## Contact Information

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Phone number: \_\_\_\_\_

Email: \_\_\_\_\_

## Airport Terminal Building - General Information

Terminal name: \_\_\_\_\_

Terminal construction year: \_\_\_\_\_

Terminal renovation year: \_\_\_\_\_

No. of gates \_\_\_\_\_

No. of floors \_\_\_\_\_

Operating Hours: Weekdays: \_\_\_\_\_ a.m. to \_\_\_\_\_ p.m.

Weekends: \_\_\_\_\_ a.m. to \_\_\_\_\_ p.m.

Holidays: \_\_\_\_\_ a.m. to \_\_\_\_\_ p.m.

# Input Form

## Airport Terminal Building – Floor Space Information

The following table provides 10 zone categories.

- (a) Please complete the “Total Airport Terminal Building Floor Area” in the last row of the table for your airport terminal building.
- (b) Please complete the floor area breakdown per Airport Terminal Zone using the “Percentage of the Total Floor Area (%)” column or the “Floor Area (ft<sup>2</sup>)” column.

### Airport Terminal Building Conditioned Space Zone Information

No.	Airport Terminal Zones	Floor Area <u>or</u> Percentage of Floor Area	
		Floor Area (ft <sup>2</sup> )	Percentage of the Total Floor Area (%)
1	Concession - Food		
2	Concession - Retail		
3	Office		
4	Transient Space		
5	Ticketing Check-In		
6	Departures Hold Room		
7	Departure/Border Security		
8	Outbound/Inbound Baggage Handling		
9	Arrivals/Baggage Claim		
10	Service (Mech/Elec/Server)		
<b>Total Airport Terminal Building Floor Area</b>			100%

# Input Form

## Airport Terminal Building - Mechanical Systems

Please complete the following tables on the mechanical systems that exist in your airport terminal building:

### Airport Terminal Building - Baggage Handling Systems Information

Type	Model No.	Manufacturer	Power (kW)	Avg. Hours of Operation /Day	No. of Units
1					
2					
3					
4					
5					

### Airport Terminal Building - People Mover Systems Information

Type	Model No.	Manufacturer	Power (kW)	Avg. Hours of Operation /Day	No. of Units
1					
2					
3					
4					
5					

### Airport Terminal Building - Escalators Information

Type	Model No.	Manufacturer	Power (kW)	Avg. Hours of Operation /Day	No. of Units
1					
2					
3					
4					
5					

### Airport Terminal Building - Elevators Information

Type	Model No.	Manufacturer	Power (kW)	Avg. Hours of Operation /Day	No. of Units
1					
2					
3					
4					
5					

# Input Form

## Airport Terminal Building - Airport Ground Support Equipment (GSE) Electricity Use

Please complete the following table on the GSE that exist in your airport terminal building:

**Airport Terminal Building – GSE Information**

GSE Type	Model No.	Manufacturer	Power (kW)	Avg. Hours of Operation/Day	No. of units
De-icing Cart					
Ramping Cart					
Jet Engine Airstart Cart					
Aircraft Tug					
Portable Ground Power					
Other: _____					



# Input Form

## Airport Terminal Building – Alternative Systems (Ground Power & PCA Power)

(a) Please provide the number of Landing and Takeoff (LTO) cycles for your terminal, per aircraft category, per year. For aircraft categories, please refer to Table 1, below, from *ACRP Report 64, Handbook for Evaluating Emissions and Costs of APUs and Alternative Systems*.

- Narrow Body, No. of LTO cycles per year: \_\_\_\_\_
- Wide Body, No. of LTO cycles per year: \_\_\_\_\_
- Jumbo-Wide Body, No. of LTO cycles per year: \_\_\_\_\_
- Regional Jet, No. of LTO cycles per year: \_\_\_\_\_
- Turbo Prop, No. of LTO cycles per year: \_\_\_\_\_

Table 1. Aircraft types and auxiliary power units grouped by aircraft category.

Aircraft Category	Example Aircraft Types	Representative APUs
Narrow Body	Boeing 737-700 Series, Boeing MD-80 Series, Airbus A320 Series, Boeing 757-200 Series, Airbus A319-100 Series, Boeing 737-800 Series, Boeing 737-300 Series, Boeing 717-200 Series, Embraer ERJ170, Embraer ERJ175.	GTCP 36-300 (80 HP), GTCP 85 (200 HP), GTCP85-98 (200 HP), GTCP85-129 (200 HP), GTCP-129H, GTCP 331-9B, GTCP 331-200, GTCP 85-98, GTCP 36-150, GTCP 36-4A.
Wide Body	Boeing 767-300 Series, Boeing 777-200 Series, Airbus A300B/C/F-600 Series, Boeing 767-200 Series, Boeing 767-400, Airbus A310-200 Series, Boeing 777-300 Series, Airbus A300B/C/F Series, Airbus A310-300 Series, Boeing 787-300 Series.	TSCP700-4B, GTCP331-200ER, GTCP331-500, APS 5000.
Jumbo - Wide Body	Boeing 747-400 Series, Airbus A330-200 Series, Airbus A340-200 Series, Boeing 747-200/300 Series, Airbus A330-300 Series, Airbus A340-600 Series, Airbus A340-300 Series, Airbus A340-500 Series, Boeing 747-100 Series, Airbus A380 Series.	GTCP 331-350, PW-980, GTCP 660, APU PW901A.
Regional Jet	Bombardier CRJ-200/400, Embraer ERJ145, Bombardier CRJ-700, Bombardier CRJ-900, Embraer ERJ140, Bombardier CRJ-100, Embraer ERJ135, Dornier 328 Jet, BAE 146-100, BAE 146-200.	GTCP 36-100, GTCP 36-150, GTCP 85.
Turbo Prop	DeHavilland DHC-8-400, DeHavilland DHC-8-100, Embraer EMB120 Brasilia, DeHavilland DHC-8-300, DeHavilland DHC-8-200, Shorts 360-100 Series, DeHavilland DHC-7 Dash 7, Embraer EMB110 Bandeirante, Fokker F27-100 Series, Fokker F27-200 Series.	T-62T-40C7, APS 1000 T-62T-46C12, GTCP 36-150, GTCP 30-54.

SOURCE: Developed from the FAA's Emissions and Dispersion Modeling System (EDMS) fleet database (FAA 2010a).

(b) Please complete the following, indicating the percentage of gates in your airport terminal building that use the specified alternative system types.

- \_\_\_\_\_% of gates - have Point of Use (POU) System.
- \_\_\_\_\_% of gates - have Central System.
- \_\_\_\_\_% of gates - have Central System with Airport Boilers

# Input Form

## Airport Terminal Building - External Lighting / Parking Lighting

Is energy consumption of external lighting/parking lighting included in the airport terminal building utility bill?

Yes       No

If “Yes”, please provide the following information:  Covered illuminated area (ft<sup>2</sup>): \_\_\_\_\_

None-covered illuminated area (ft<sup>2</sup>): \_\_\_\_\_

(i.e., open to the sky)

# Input Form

## Airport Terminal Building - Performance and Utilities Information

Please provide 12-month metered utility data if available for the airport terminal building. If monthly utility information is not available, please provide the Total Annual energy use.

### Airport Terminal Building – Utility Information For the Period: \_\_\_\_\_ (m/d/year-m/d/year)

	Date of Utility Bill (m/d/year-m/d/year)	Electricity (kWh/month)	Natural Gas (Units: <input type="checkbox"/> CCF <input type="checkbox"/> MCF <input type="checkbox"/> Therms)	Other: _____ (Units: _____)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
Total Annual				

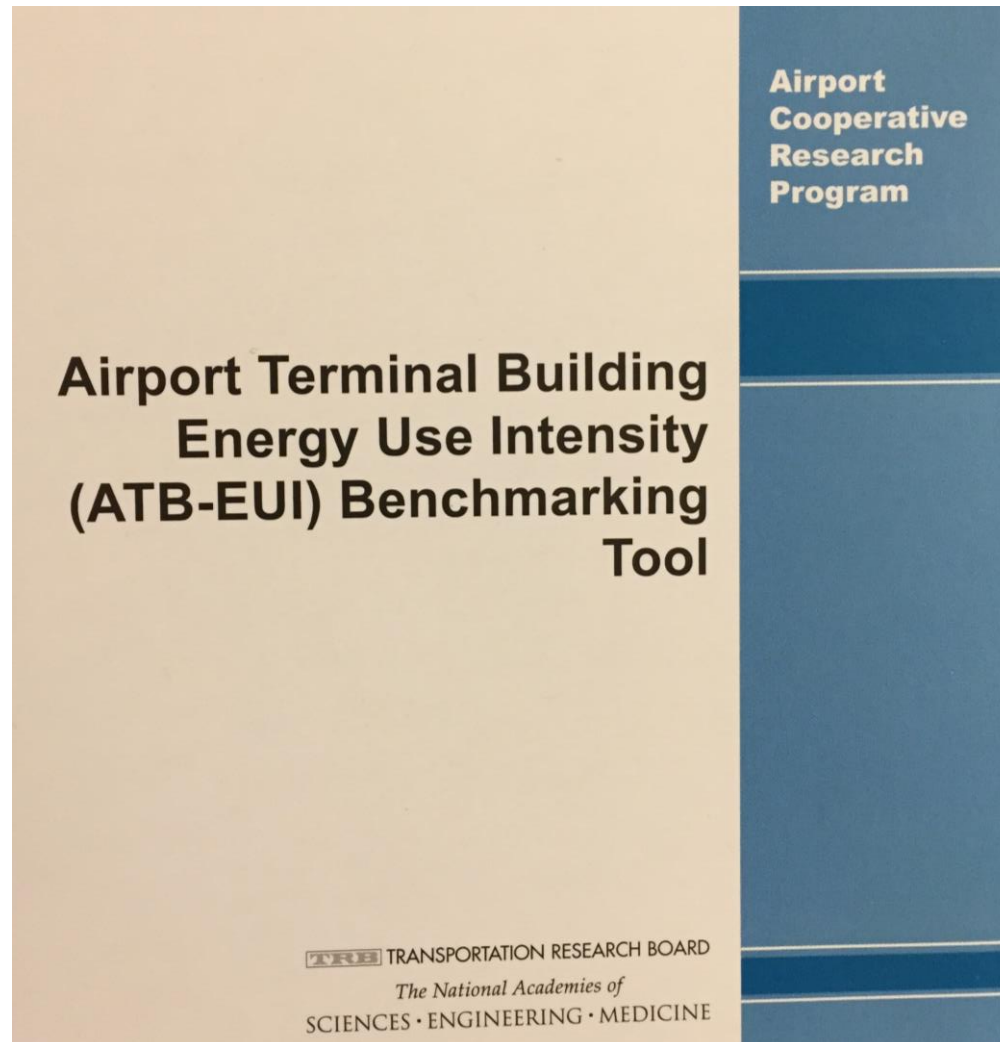
Is monthly sub-metered utility data available for the airport terminal building?

Yes       No

If "Yes", please check all that apply:

Electricity       Natural gas       Other (please specify): \_\_\_\_\_

# Benchmarking Tool





**CATEE 2016**

Clean Air Through Energy Efficiency Conference

December 19-21, 2016  
San Antonio, Texas

**ACRP 09-10  
BENCHMARKING AND PROFILING AIRPORT  
TERMINAL ENERGY END USES**

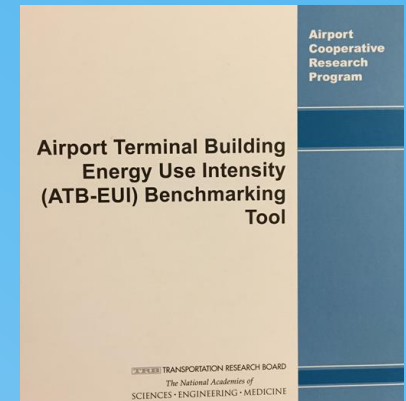
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**ENERGY SYSTEMS LABORATORY**  
TEXAS A&M ENGINEERING EXPERIMENT STATION



**Energy  
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