

A Universal Model for Hybrid HVAC Equipment in Building Energy Simulations

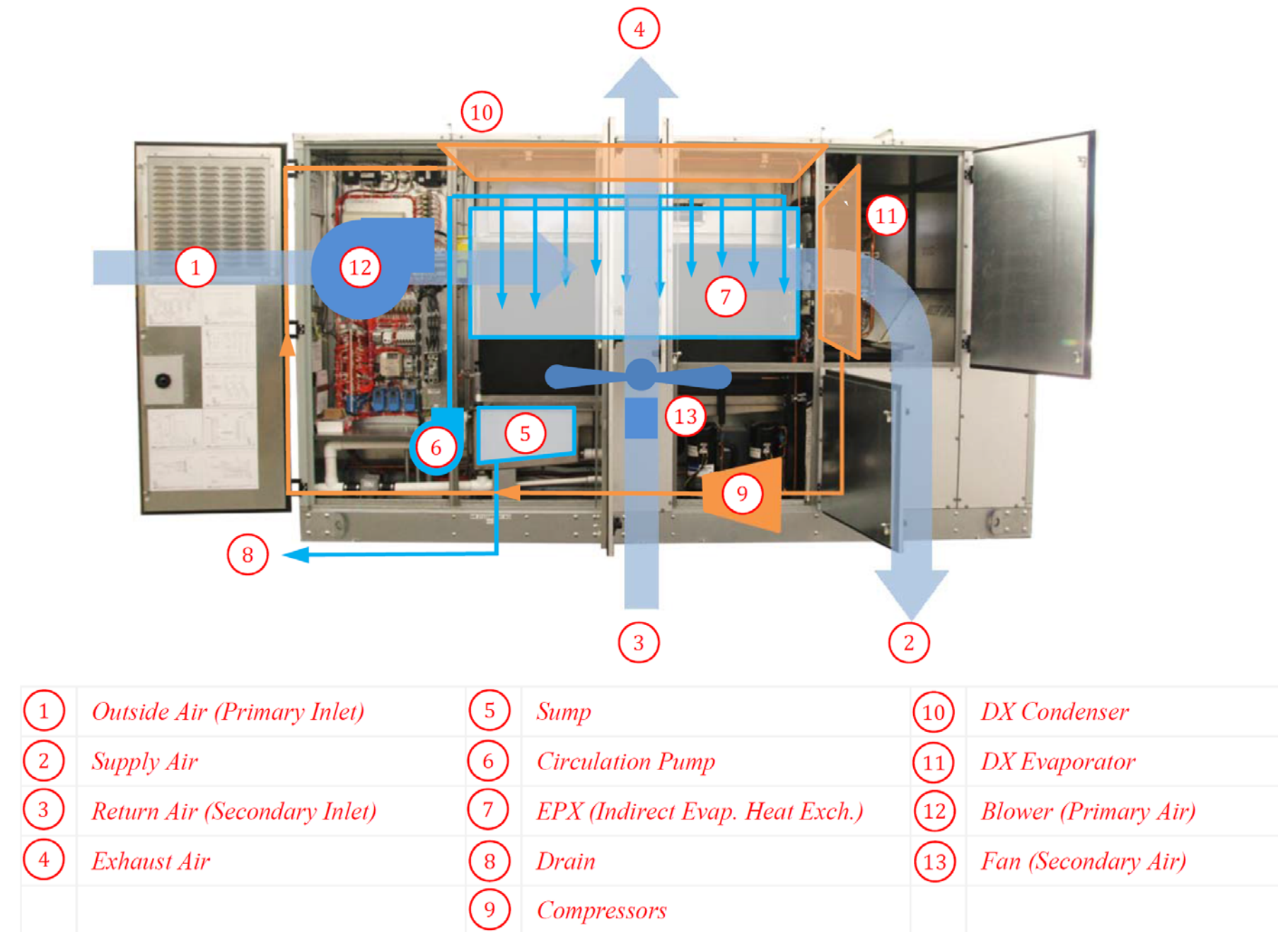
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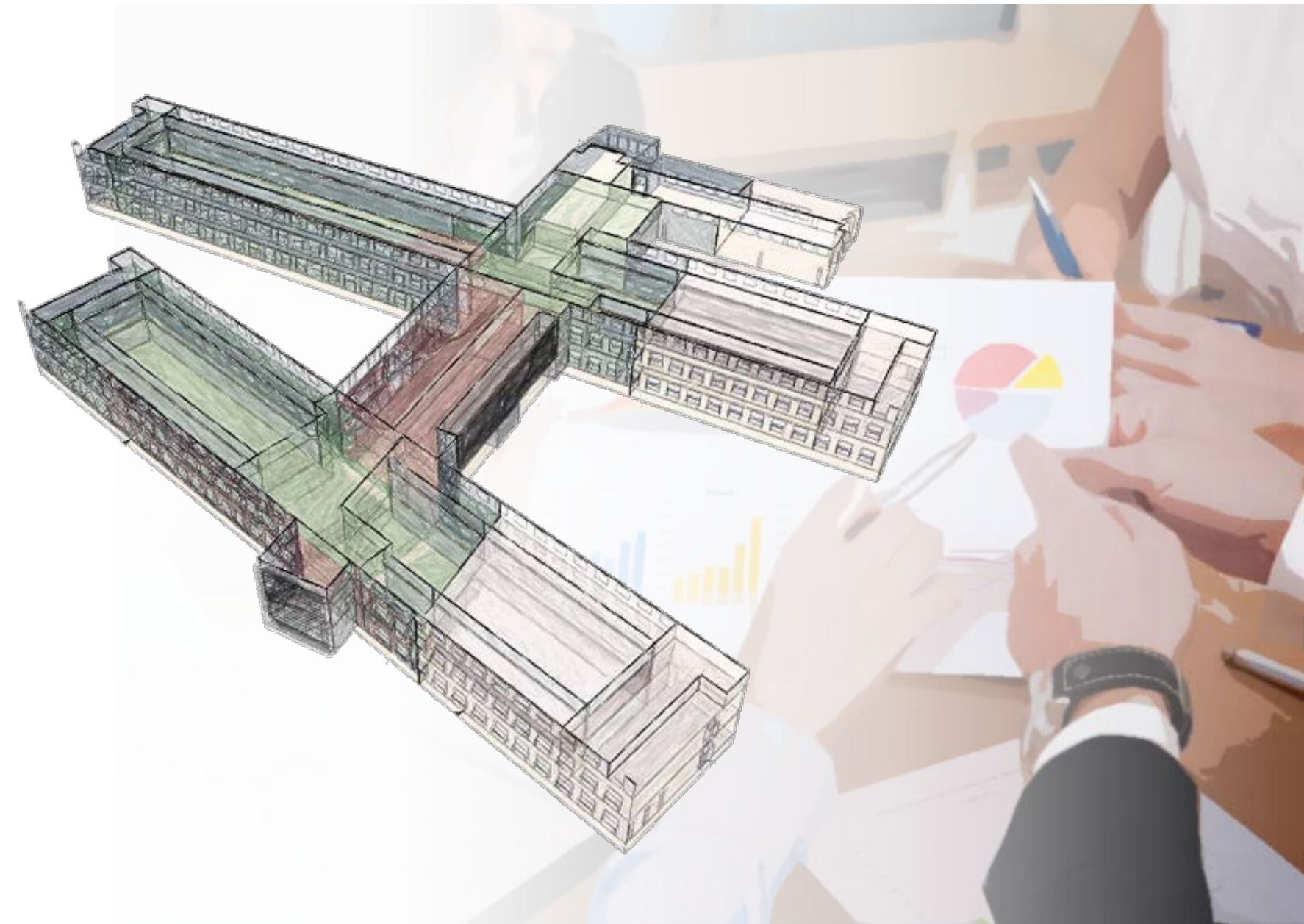
Overview of Hybrid HVAC

- » Include multiple cooling strategies and switch between numerous operating modes to heat/cool/dehumidify more efficiently across a range of operating conditions
- » Integrate component operations for mutualistic efficiency advantages
- » Some advanced technologies include
 - Variable speed fans and compressors
 - Heat recovery
 - Desiccant dehumidification
 - Indirect evaporative cooling (various types)
 - Evaporative condenser cooling
- » Best strategy differs by climate and application
- » Can reduce peak demand by 40% or more
- » Can achieve 65% savings for annual cooling energy consumption

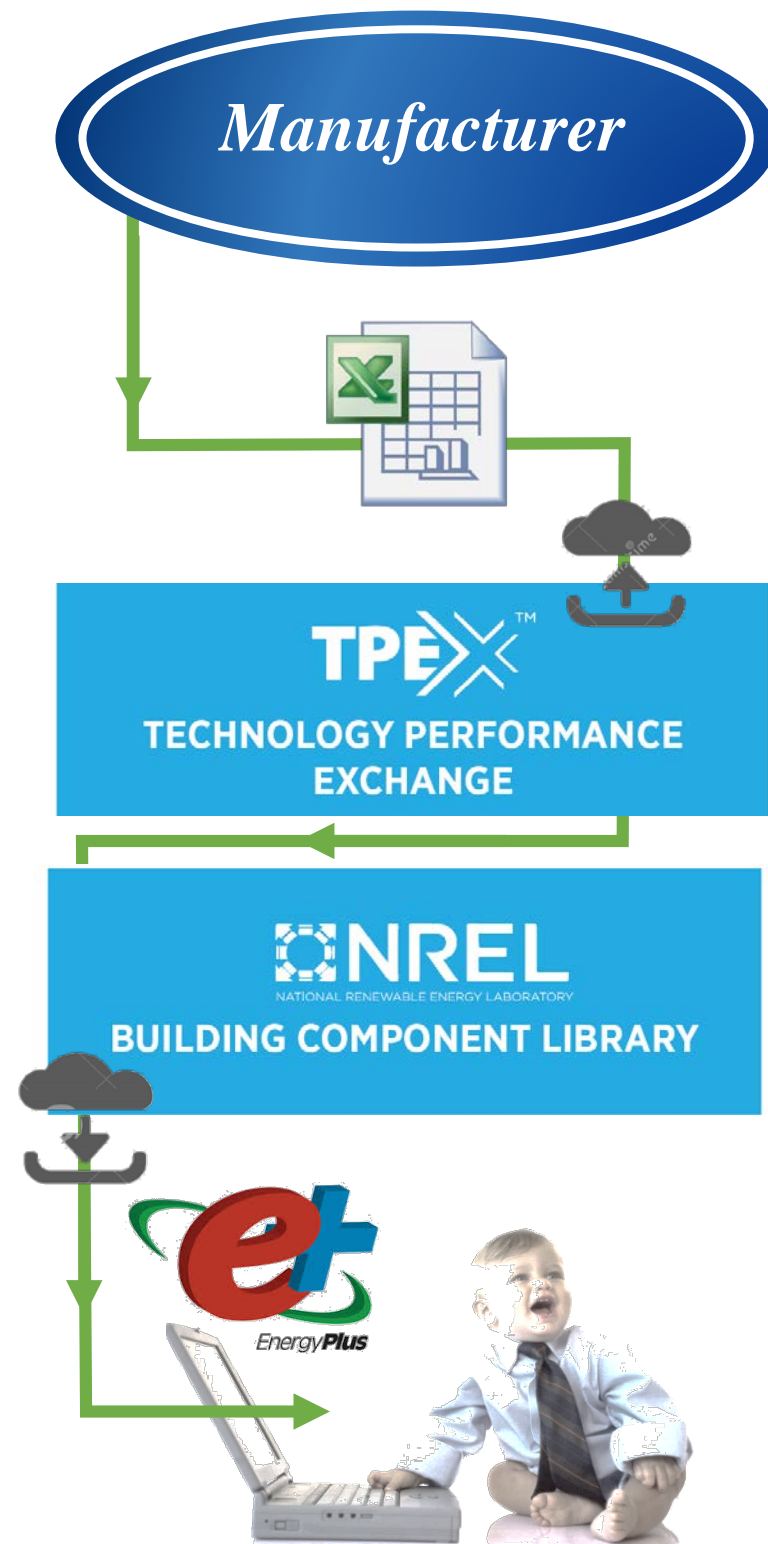


Why we need a standard model for hybrid unitary HVAC

- » There are many unique hybrid system architectures
- » Current building energy simulations tools are not capable of modeling most hybrid systems
- » It is infeasible for practitioners to model systems from first principals
- » Previous simulations are not comparable, and not transferable
- » Need a compliance pathway for Building Energy Efficiency Standards
- » Utilities, energy service companies, and efficiency programs need accurate projections of energy savings and demand reductions
- » Engineers require parametric simulation of alternatives
- » Customers require cost justification



Overall information workflow for our model



- » Manufacturers that publish data benefit from public modeling capabilities
- » Equipment performance data input to a standard format template
- » Manufacturers upload data to Technology Performance Exchange
- » Users download data from Building Component Library
- » EnergyPlus “Hybrid Unitary HVAC” is simple to use

Technology Performance Exchange – <https://www.tpex.org>

The screenshot shows the Technology Performance Exchange (TPEX) website. The page title is "Technology Categories" and the subtitle is "Browse By Technology Category". The website features a navigation menu with "Home", "Technology Categories", "Companies", "About", and "Developers". The user is logged in as "JWoolley" and can access "Logoff" and "My Account".

The main content area lists several technology categories with their respective counts and descriptions:

- Electric Lighting** (8694): Technology categories contained in the Electric Lighting group pertain to the use of electric power to provide space illumination. Lighting sources, as well as technologies that enable the generation of, or distribute or direct electrically-generated light, are also included within this group.
- HVAC** (2652): Technology categories contained in the Heating, Ventilation, and Air-Conditioning Group pertain to products used to provide thermal control to a space or working fluid, or those products that support the delivery of such fluids, and whose primary purpose is to support process thermal load requirements, ensure occupant comfort, or maintain acceptable indoor air quality.
 - Boilers** (829): The Boiler subgroup includes HVAC products whose primary function is to transfer energy to water or steam for space conditioning or process heating applications.
 - Compressors** (0): The Compressor subgroup includes HVAC products whose primary function is to increase the pressure of a working fluid.
 - Ductless Heat Pumps** (199): The Ductless Heat Pump subgroup includes heating, ventilating, and air-conditioning (HVAC) products that use a refrigerant as the transport medium between indoor terminal units and outdoor units, as opposed to more traditional ducted systems that use air as the transport medium.
 - Packaged Unitary Equipment** (1623): This subgroup includes HVAC products that are (1) contained within a single housing; and (2) whose primary function typically involves the conditioning of an airstream via a set of integrated heating and/or cooling coils.

The website also features the NREL logo and a search bar. The browser's address bar shows the URL "https://www.tpex.org/technology-categories". The taskbar at the bottom of the screen displays various application icons and the system clock showing 11:13 AM on 5/14/2017.

Building Component Library – <https://bcl.nrel.gov/>

The screenshot shows the Building Component Library website interface. The browser address bar displays the URL: [https://bcl.nrel.gov/search/site?page=1&f\[0\]=im_field_component_tags%3A1337](https://bcl.nrel.gov/search/site?page=1&f[0]=im_field_component_tags%3A1337). The page title is "Building Component Library".

At the top right, there is a "Welcome, Guest!" message and a "Login" link. Below this is a search bar with a "Search" button and a "Download Selected" button.

The main content area displays a list of components. The first component is highlighted in orange:

Component Name	Date	Manufacturer
LG Electronics USA ARNU183TQC2	7/3/2016	NREL Technology
LG Electronics USA ARNU153TQC2	7/3/2016	
LG Electronics USA ARNU763B8A2	7/3/2016	
LG Electronics USA ARNU483TMC2	7/3/2016	
LG Electronics USA ARNU363NJA2	7/3/2016	
LG Electronics USA ARNU183B4G2	7/3/2016	
LG Electronics USA ARNU073TJC2	7/3/2016	
LG Electronics USA ARNU183B2G2	7/3/2016	
LG Electronics USA ARNU123SER2	7/3/2016	

A detailed view of the selected component, "LG Electronics USA ARNU363NJA2", is shown in a pop-up window:

- Rated Cooling Capacity: 10600
- Rated Heating Capacity: 11700
- Rated Cooling Air Flow Rate: 0.52
- Rated Heating Air Flow Rate: 0.52
- Manufacturer: LG Electronics USA
- TPE uuid: 12b0b860-0875-4d68-a734-cc1b8160151f
- OpenStudio Type: OS:ZoneHVAC:TerminalUnit:VariableRefrigerantFlow
- Brand: LG Electronics USA

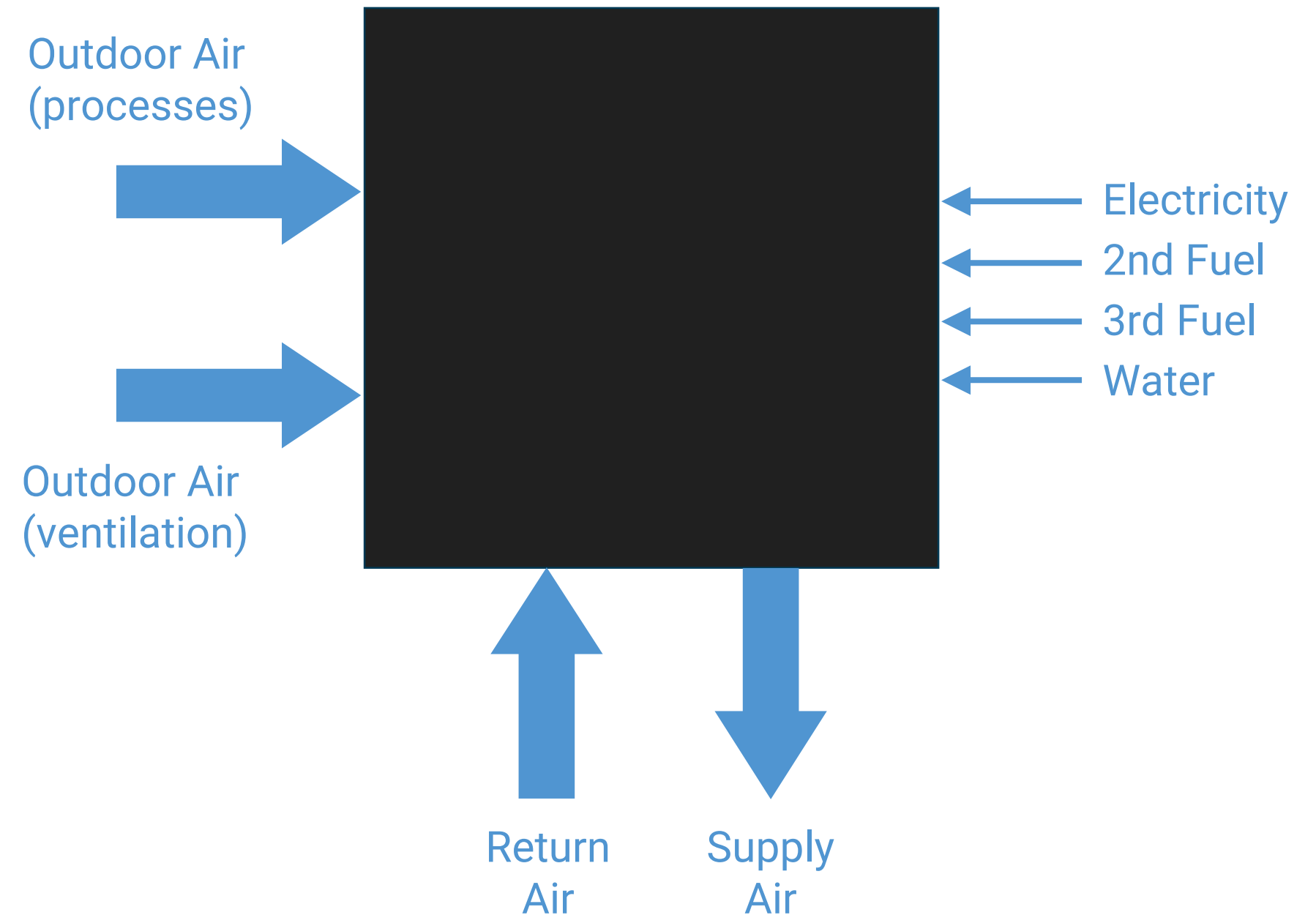
On the left side, there are filter options:

- Sort by:** Relevancy, Title, Type, Author, Date
- Filter by type:** Component (132)
- Filter by tags:** HVAC
 - Ductless Heat Pump
 - Indoor Unit (78)
 - Outdoor Unit (54)
- Filter by group:** NREL Technology Performance Exchange (130)

The Windows taskbar at the bottom shows the system time as 11:24 AM on 5/14/2017.

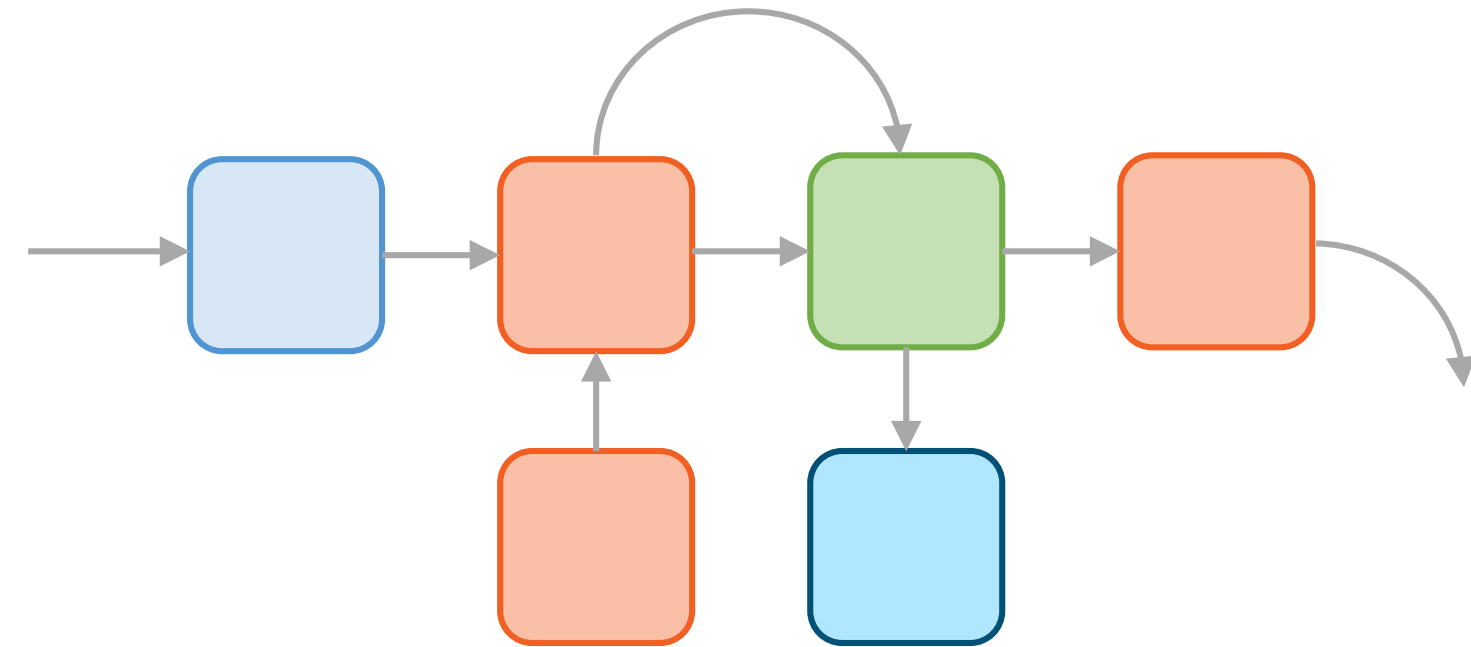
Basic formulation for our model

- » A new ZoneHVAC object class in EnergyPlus
- » Accommodates any unitary HVAC system
- » May have return air, outdoor air, and supply air streams
- » May consume electricity, water, and two other fuels
- » An empirical model, does not require definition of internal elements
- » Allows many operating modes
- » Responds to need for heating, cooling, dehumidification, and ventilation

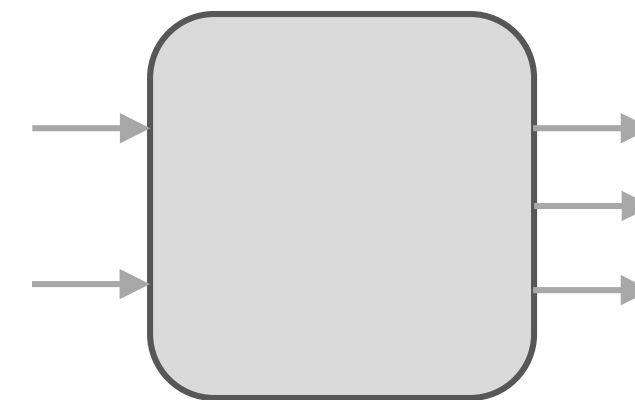


Why we chose an empirical (black box) model

- » It is infeasible to expect practitioners to model hybrid systems from first principals
- » A sub-component based model approach is useful, but limited, and slow to evolve
 - Must have a standard model for every sub component
 - Models must be flexible enough to accommodate many architectures
 - New component innovations cannot be immediately represented
- » An empirical model minimizes confusion for practitioners
- » 1 product = 1 empirical data set
- » More reliable and flexible for compliance
- » Protects trade secrets



A sub-component based model approach



A black box model approach

Technology Performance Exchange – <https://www.tpex.org>

DETAILED DATA

All or the majority of measurements below were derived by... ?

- None -

AHRI Certified Reference Number ?

- None -

Nominal Cooling Capacity (kW) ?

- None -

Energy Efficiency Ratio ((BTU/h)/Watt) ?

- None -

Integrated Energy Efficiency Ratio ((BTU/h)/Watt) ?

- None -

Seasonal Energy Efficiency Ratio ((BTU/h)/Watt) ?

- None -

Cooling Mode: Supply Fan Speed Control

- None - - None -

Cooling Mode: Number of Discrete Fan Speeds ?

- None -

Cooling Mode: Minimum Fan Speed as a Fraction of Maximum ?

- None -

Heating Mode: Supply Fan Speed Control ?

- None -

Manufacturer: Carrier Air Conditioning - Commercial

Brand: Arcoaire

Product Line / Family Name: ARCOAIRE

Model or Product Number: RAH072(H,L,S)*****

Performance Map Template (Screenshot)

The screenshot shows an Excel spreadsheet with the following structure:

- Step 1: Product Information** (Rows 3-6):

Brand Owner	
Brand	
Product Line/Family Name	
Model Number	
- Step 2: Mode Characteristics** (Rows 9-19):

Name of operating mode	
Does performance in this mode depend on outside air temperature?	-
Does performance in this mode depend on outside air humidity?	-
Does performance in this mode depend on return air temperature?	-
Does performance in this mode depend on return air humidity?	-
Does supply air mass flow rate change within this mode?	-
Does outside air fraction change within this mode?	-
Does the equipment consume electricity in this mode?	-
Does the equipment consume water in this mode?	-
Does the equipment consume a second fuel in this mode? What type?	-
Does the equipment consume a third fuel in this mode? What type?	-
- Step 3: Extents of Data Table** (Rows 22-30):

	minimum	maximum
Outside Air Temperature (°C)		
Outside Air Relative Humidity (0-100%)		
Outside Air Humidity Ratio (g/g)		
Return Air Temperature (°C)		
Return Air Relative Humidity (0-100%)		
Return Air Humidity Ratio (g/g)		
Supply Air Mass Flow Rate (kg/s)		
Outside Air Fraction (0-1)		
- Step 4: Limits for Extrapolation Beyond Data Table** (Rows 33-41):

	minimum	maximum
Outside Air Temperature (°C)		
Outside Air Relative Humidity (0-100%)		
Outside Air Humidity Ratio (g/g)		
Return Air Temperature (°C)		
Return Air Relative Humidity (0-100%)		
Return Air Humidity Ratio (g/g)		
Supply Air Mass Flow Rate (kg/s)		
Outside Air Fraction (0-1)		
- Step 5: Performance Data Table** (Rows 44-48):

Test Number	Outside Air	Outside Air	Return Air	Return Air	Supply Air	Outside Air	External Static	-	-	-	-	-	-	-
1	-	-	-	-	0	0	0							
-	-	-	-	-	-	-	-							
-	-	-	-	-	-	-	-							
-	-	-	-	-	-	-	-							
- Instructions** (Rows 29-37):

Instructions	
	Fill this information in first
	Conditions in these cells are automatically populated
	Input performance data in these cells for the conditions provided

The spreadsheet is titled 'PerformanceMapTemplate.xlsx' and is open in the 'Hybrid AC Data' worksheet. The status bar shows 'Ready' and the system tray includes a clock for 6:53 PM on 5/12/2017.

Each operating mode is a distinct combination of system subcomponent functions

Mode	Primary Blower	Secondary Fan	Compressor 1	Compressor 2	Circulation Pump	Heat
Indirect Evaporative Cooling	ON	ON	OFF	OFF	ON	OFF
Indirect Evaporative & DX1	ON	ON	ON	OFF	ON	OFF
Indirect Evaporative & DX2	ON	ON	ON	ON	ON	OFF
Ventilation Only	ON	ON	OFF	OFF	OFF	OFF
Heating	ON	ON	OFF	OFF	OFF	ON

Performance map template

Step 1: Product Information	
Brand Owner	
Brand	
Product Line/Family Name	
Model Number	

Step 2: Mode Characteristics	
Name of operating mode	
Does performance in this mode depend on outside air temperature?	-
Does performance in this mode depend on outside air humidity?	-
Does performance in this mode depend on return air temperature?	-
Does performance in this mode depend on return air humidity?	-
Does supply air mass flow rate change within this mode?	-
Does outside air fraction change within this mode?	-
Does the equipment consume electricity in this mode?	-
Does the equipment consume water in this mode?	-
Does the equipment consume a second fuel in this mode? What type?	-
Does the equipment consume a third fuel in this mode? What type?	-

Instructions	
	Fill this information in first
	Conditions in these cells are automatically populated
	Input performance data in these cells for the conditions provided

Performance map template

Step 1: Product Information	
Brand Owner	Munters Corp
Brand	Munters
Product Line/Family Name	HCUc
Model Number	6030

Step 2: Mode Characteristics	
Name of operating mode	Cool DCBA
Does performance in this mode depend on outside air temperature?	Yes
Does performance in this mode depend on outside air humidity?	Yes
Does performance in this mode depend on return air temperature?	No
Does performance in this mode depend on return air humidity?	No
Does supply air mass flow rate change within this mode?	Yes
Does outside air fraction change within this mode?	No
Does the equipment consume electricity in this mode?	Yes
Does the equipment consume water in this mode?	No
Does the equipment consume a second fuel in this mode? What type?	No
Does the equipment consume a third fuel in this mode? What type?	No

Instructions	
	Fill this information in first
	Conditions in these cells are automatically populated
	Input performance data in these cells for the conditions provided

Performance map template

Step 3: Extents of Data Table		
	minimum	maximum
Outside Air Temperature (°C)		
Outside Air Relative Humidity (0-100%)		
Outside Air Humidity Ratio (g/g)		
Return Air Temperature (°C)		
Return Air Relative Humidity (0-100%)		
Return Air Humidity Ratio (g/g)		
Supply Air Mass Flow Rate (kg/s)		
Outside Air Fraction (0-1)		

Step 4: Limits for Extrapolation Beyond Data Table		
	minimum	maximum
Outside Air Temperature (°C)		
Outside Air Relative Humidity (0-100%)		
Outside Air Humidity Ratio (g/g)		
Return Air Temperature (°C)		
Return Air Relative Humidity (0-100%)		
Return Air Humidity Ratio (g/g)		
Supply Air Mass Flow Rate (kg/s)		
Outside Air Fraction (0-1)		

Instructions	
	Fill this information in first
	Conditions in these cells are automatically populated
	Input performance data in these cells for the conditions provided

Performance map template

Step 3: Extents of Data Table		
	minimum	maximum
Outside Air Temperature (°C)	35.0	49.0
Outside Air Relative Humidity (0-100%)	0	100
Outside Air Humidity Ratio (g/g)	0.006857143	0.016
Return Air Temperature (°C)		
Return Air Relative Humidity (0-100%)		
Return Air Humidity Ratio (g/g)		
Supply Air Mass Flow Rate (kg/s)	2.62	3.58
Outside Air Fraction (0-1)	1.00	1.00

Step 4: Limits for Extrapolation Beyond Data Table		
	minimum	maximum
Outside Air Temperature (°C)		
Outside Air Relative Humidity (0-100%)		
Outside Air Humidity Ratio (g/g)		
Return Air Temperature (°C)		
Return Air Relative Humidity (0-100%)		
Return Air Humidity Ratio (g/g)		
Supply Air Mass Flow Rate (kg/s)		
Outside Air Fraction (0-1)		

Instructions	
	Fill this information in first
	Conditions in these cells are automatically populated
	Input performance data in these cells for the conditions provided

Performance map template

Instructions	
	Fill this information in first
	Conditions in these cells are automatically populated
	Input performance data in these cells for the conditions provided

Step 5: Performance Data Table														
Test Number	Outside Air Temperature (°C)	Outside Air Humidity Ratio (g/g)	Return Air Temperature (°C)	Return Air Humidity Ratio (g/g)	Supply Air Mass Flow (kg/s)	Outside Air Fraction	External Static Pressure (Pa)	-	-	-	-	-	-	-
1	-	-	-	-	0	0	0							
-	-	-	-	-	-	-	-							
-	-	-	-	-	-	-	-							
-	-	-	-	-	-	-	-							
-	-	-	-	-	-	-	-							
-	-	-	-	-	-	-	-							
-	-	-	-	-	-	-	-							
-	-	-	-	-	-	-	-							
-	-	-	-	-	-	-	-							
-	-	-	-	-	-	-	-							
-	-	-	-	-	-	-	-							
-	-	-	-	-	-	-	-							

Performance map template

Instructions	
	Fill this information in first
	Conditions in these cells are automatically populated
	Input performance data in these cells for the conditions provided

Step 5: Performance Data Table														
Test Number	Outside Air Temperature (°C)	Outside Air Humidity Ratio (g/g)	Return Air Temperature (°C)	Return Air Humidity Ratio (g/g)	Supply Air Mass Flow (kg/s)	Outside Air Fraction	External Static Pressure (Pa)	Supply Air Temperature (°C)	Supply Air Humidity Ratio (g/g)	Total Electric Power (kW)	Supply Fan Electric Power (kW)	-	-	
1	26.67	0.0187	-	-	2.611	1	114	20	0.0051	29.24	2.4			
2	26.67	0.0187	-	-	2.925	1	143	20.56	0.0061	30.14	3			
3	26.67	0.0187	-	-	3.239	1	175	21.11	0.007	31.34	3.7			
4	26.67	0.0222	-	-	2.603	1	11	21.11	0.0069	30.04	2.4			
5	26.67	0.0222	-	-	2.917	1	142	21.67	0.0079	31.04	3			
6	26.67	0.0222	-	-	3.227	1	173	22.78	0.0087	32.04	3.8			
7	26.67	0.0222	-	-	2.603	1	113	21.11	0.0069	30.04	2.4			
8	26.67	0.0222	-	-	2.917	1	142	21.67	0.0079	31.04	3			
9	26.67	0.0222	-	-	3.227	1	174	22.78	0.0087	32.04	3.8			
10	36.39	0.0187	-	-	2.590	1	112	24.44	0.0066	36.04	2.4			
11	36.39	0.0187	-	-	2.901	1	141	25.56	0.0074	36.94	3			
12	36.39	0.0187	-	-	3.212	1	172	26.67	0.0081	37.94	3.8			
13	36.39	0.0244	-	-	2.578	1	111	27.22	0.0093	36.94	2.4			

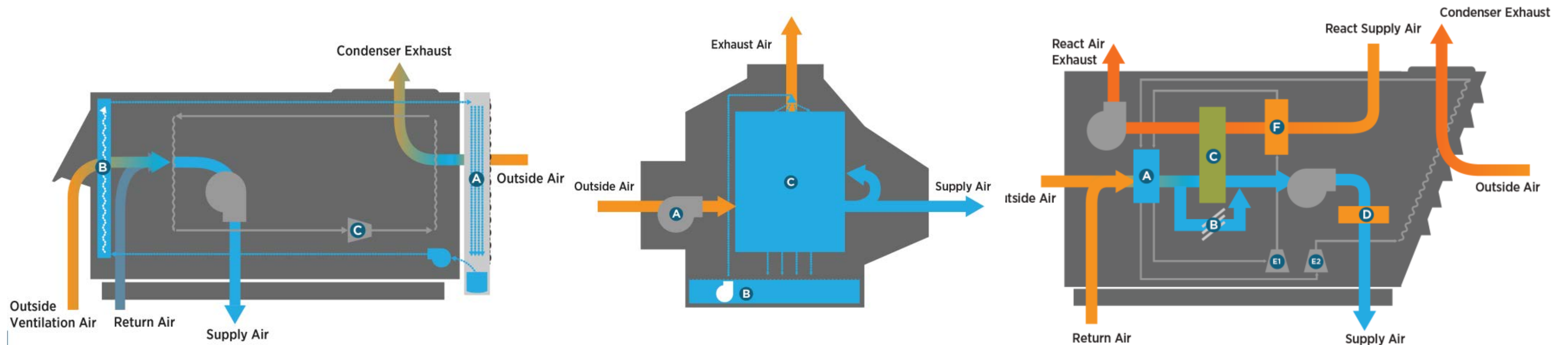
Industry collaboration

- » Partnered with three manufacturers to develop initial performance maps and to test new EnergyPlus features
- » 2015-2016 focused on developing performance maps with each manufacturer
- » Working with NREL to expand Technology Performance Exchange
- » Working with LBNL to integrate model into EnergyPlus
- » Currently pilot testing new features and continuing development
- » Targeting public release in Fall 2017



Manufacturer partners will submit initial performance maps

- » IntegratedComfort – DualCool – 8 modes
- » Seeley – ClimateWizard – 3 modes
- » Mutners – Humidity Control Unit – 15 modes



DualCool

ClimateWizard

HCU

EnergyPlus Interface



IDF Editor - [C:\Users\nidhoggr\Desktop\EnergyPlusSandbox\SANDBOXPrototypeVersion\20170510_SingleZoneHybridExample_rev0510\SingleZoneHybridExample_rev0510.idf]

File Edit View Jump Window Help

New Obj Dup Obj Del Obj Copy Obj Paste Obj

Class List

- Zone HVAC Forced Air Units
- [-----] ZoneHVAC:IdealLoadsAirSystem
- [-----] ZoneHVAC:FourPipeFanCoil
- [-----] ZoneHVAC:WindowAirConditioner
- [-----] ZoneHVAC:PackagedTerminalAirConditioner
- [-----] ZoneHVAC:PackagedTerminalHeatPump
- [-----] ZoneHVAC:WaterToAirHeatPump
- [-----] ZoneHVAC:Dehumidifier:DX
- [-----] ZoneHVAC:EnergyRecoveryVentilator
- [-----] ZoneHVAC:EnergyRecoveryVentilator:Controller
- [-----] ZoneHVAC:UnitVentilator
- [-----] ZoneHVAC:UnitHeater
- [-----] ZoneHVAC:EvaporativeCoolerUnit
- [0001] ZoneHVAC:HybridUnitaryAC**
- [-----] ZoneHVAC:OutdoorAirUnit
- [-----] ZoneHVAC:OutdoorAirUnit:EquipmentList
- [-----] ZoneHVAC:TerminalUnit:VariableRefrigerantFlow
- Zone HVAC Radiative/Convective Units
- [-----] ZoneHVAC:Baseboard:RadiantConvective:Water
- [-----] ZoneHVAC:Baseboard:RadiantConvective:Steam
- [-----] ZoneHVAC:Baseboard:RadiantConvective:Electric
- [-----] ZoneHVAC:CoolingPanel:RadiantConvective:Water
- [-----] ZoneHVAC:Baseboard:Convective:Water
- [0001] ZoneHVAC:Baseboard:Convective:Electric
- [-----] ZoneHVAC:LowTemperatureRadiant:VariableFlow
- [-----] ZoneHVAC:LowTemperatureRadiant:ConstantFlow
- [-----] ZoneHVAC:LowTemperatureRadiant:Electric
- [-----] ZoneHVAC:LowTemperatureRadiant:SurfaceGroup
- [-----] ZoneHVAC:HighTemperatureRadiant
- [-----] ZoneHVAC:VentilatedSlab
- [-----] ZoneHVAC:VentilatedSlab:SlabGroup
- Zone HVAC Air Loop Terminal Units
- [-----] AirTerminal:SingleDuct:Uncontrolled
- [-----] AirTerminal:SingleDuct:ConstantVolume:Reheat
- [-----] AirTerminal:SingleDuct:VAV:NoReheat
- [-----] AirTerminal:SingleDuct:VAV:Reheat
- [-----] AirTerminal:SingleDuct:VAV:Reheat:VariableSpeedFan
- [-----] AirTerminal:SingleDuct:VAV:HeatAndCool:NoReheat
- [-----] AirTerminal:SingleDuct:VAV:HeatAndCool:Reheat
- [-----] AirTerminal:SingleDuct:SeriesPIU:Reheat
- [-----] AirTerminal:SingleDuct:ParallelPIU:Reheat
- [-----] AirTerminal:SingleDuct:ConstantVolume:FourPipeInduction
- [-----] AirTerminal:SingleDuct:ConstantVolume:FourPipeBeam
- [-----] AirTerminal:SingleDuct:ConstantVolume:CooledBeam
- [-----] AirTerminal:SingleDuct:Mixer
- [-----] AirTerminal:DualDuct:ConstantVolume
- [-----] AirTerminal:DualDuct:VAV
- [-----] AirTerminal:DualDuct:VAV:OutdoorAir
- [-----] ZoneHVAC:AirDistributionUnit

Comments from IDF

Explanation of Object and Current Field

Object Description: Hybrid Unitary HVAC. A black box model for multi-mode packaged forced air equipment. Independent variables include outside air conditions and indoor air conditions. Controlled inputs include operating mode, supply air flow rate, and outside air fraction. Empirical lookup tables are required to map supply air temperature supply air humidity, electricity use, fuel uses, water use, fan electricity use, and external static pressure as a function of each independent variable and each controlled input. Equipment in this class may consume electricity, water, and up to two additional fuel types.

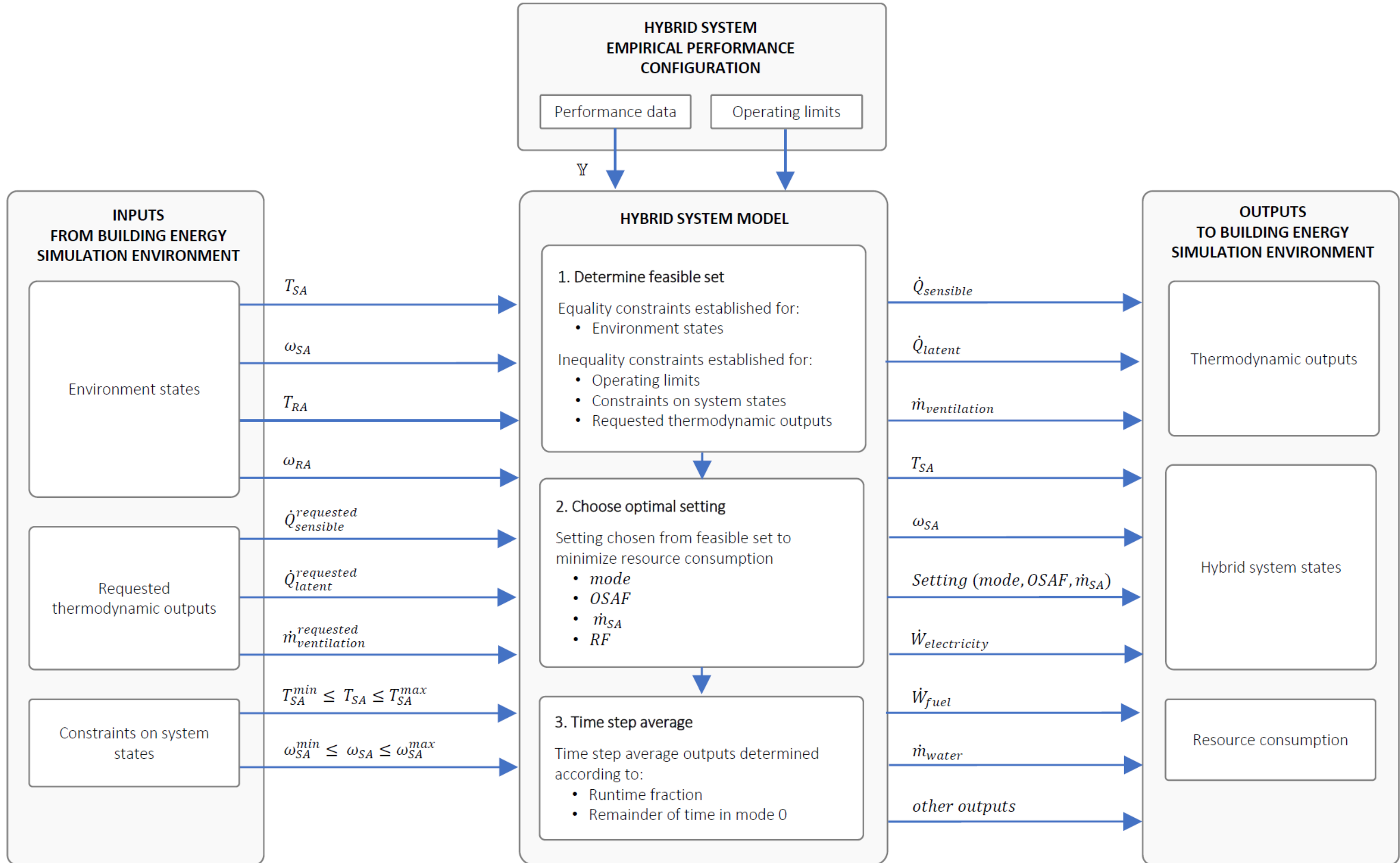
Field Description:
ID: A1
Enter a alphanumeric value
This field is required.

Field	Units	Obj
Name		HYBRID
Availability Schedule Name		ALWAYS_ON
Availability Manager List Name		
Minimum Supply Air Temperature Schedule Name		MinSupplyT
Maximum Supply Air Temperature Schedule Name		MaxSupplyT
Minimum Supply Air Humidity Ratio Schedule Name		MinSupplyHR
Maximum Supply Air Humidity Ratio Schedule Name		MaxSupplyHR
Method to Choose Value of Controlled Inputs		AUTOMATIC
Method to determine part mode fraction		SIMPLE
Return Air Node Name		Main Return Air Node Nam
Outside Air Node Name		Outside Air Inlet Node
Supply Air Node Name		Main Zone Inlet Node
Relief Node Name		Main Relief Node
System Maximum Supply AirFlow Rate	m3/s	10
External Static Pressure at System Maximum Supply Air	Pa	
Scaling Factor		10
Number of Operating Modes		3
Minimum Time Between Mode Change	minutes	10
First fuel type		Electricity
Second fuel type		NaturalGas
Third fuel type		DistrictCooling
Objective Function Minimizes		Electricity Use
Mode0 Name		Mode0 Name
Mode0 Supply Air Temperature Lookup Table Name		Mode0_TSA_lookup
Mode0 Supply Air Humidity Ratio Lookup Table Name		Mode0_wSA_lookup
Mode0 System Electric Power Lookup Table Name		Mode0_Power_lookup
Mode0 Supply Fan Electric Power Lookup Table Name		Mode0_FanPower_lookup
Mode0 External Static Pressure Lookup Table Name		Mode0_ESP_lookup
Mode0 System Second Fuel Consumption Lookup Table		Mode0_2ndFuel_lookup
Mode0 System Third Fuel Consumption Lookup Table		Mode0_3rdFuel_lookup
Mode0 System Water Use Lookup Table Name		Mode0_water_lookup

energy+.idd | EnergyPlus 8.7.0 | HYBRID

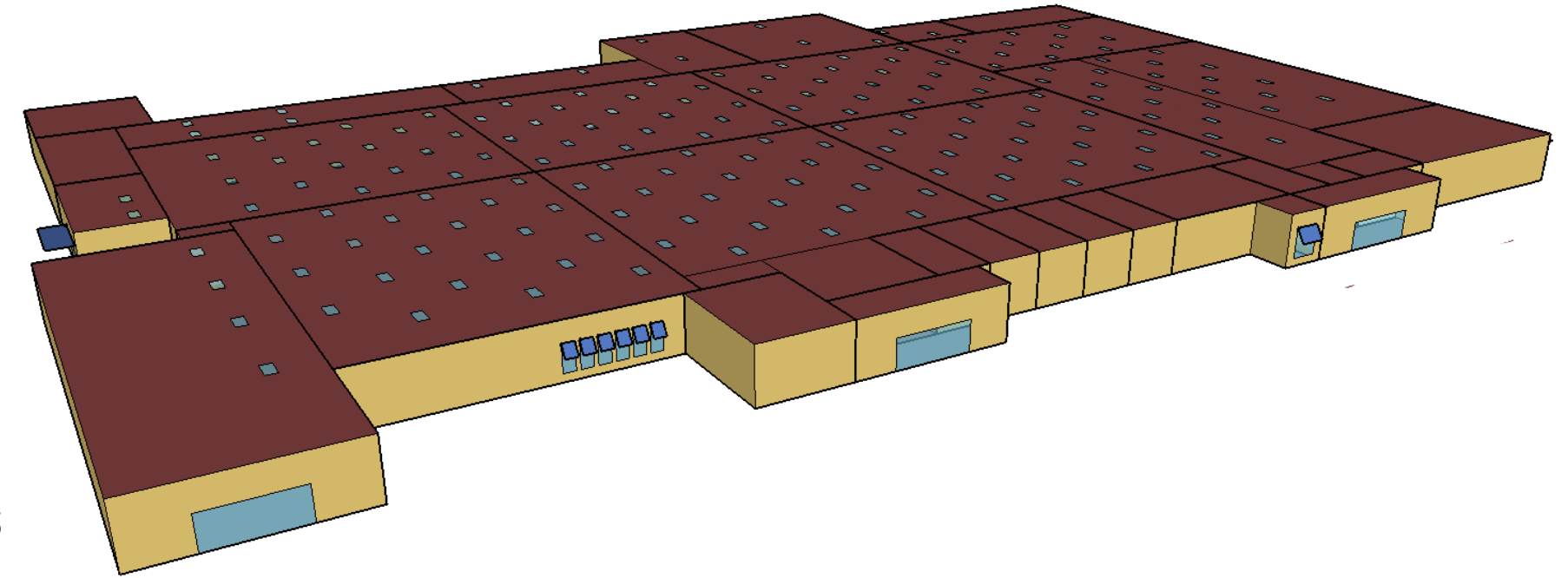
10:11 PM 5/14/2017

Schematic of model architecture



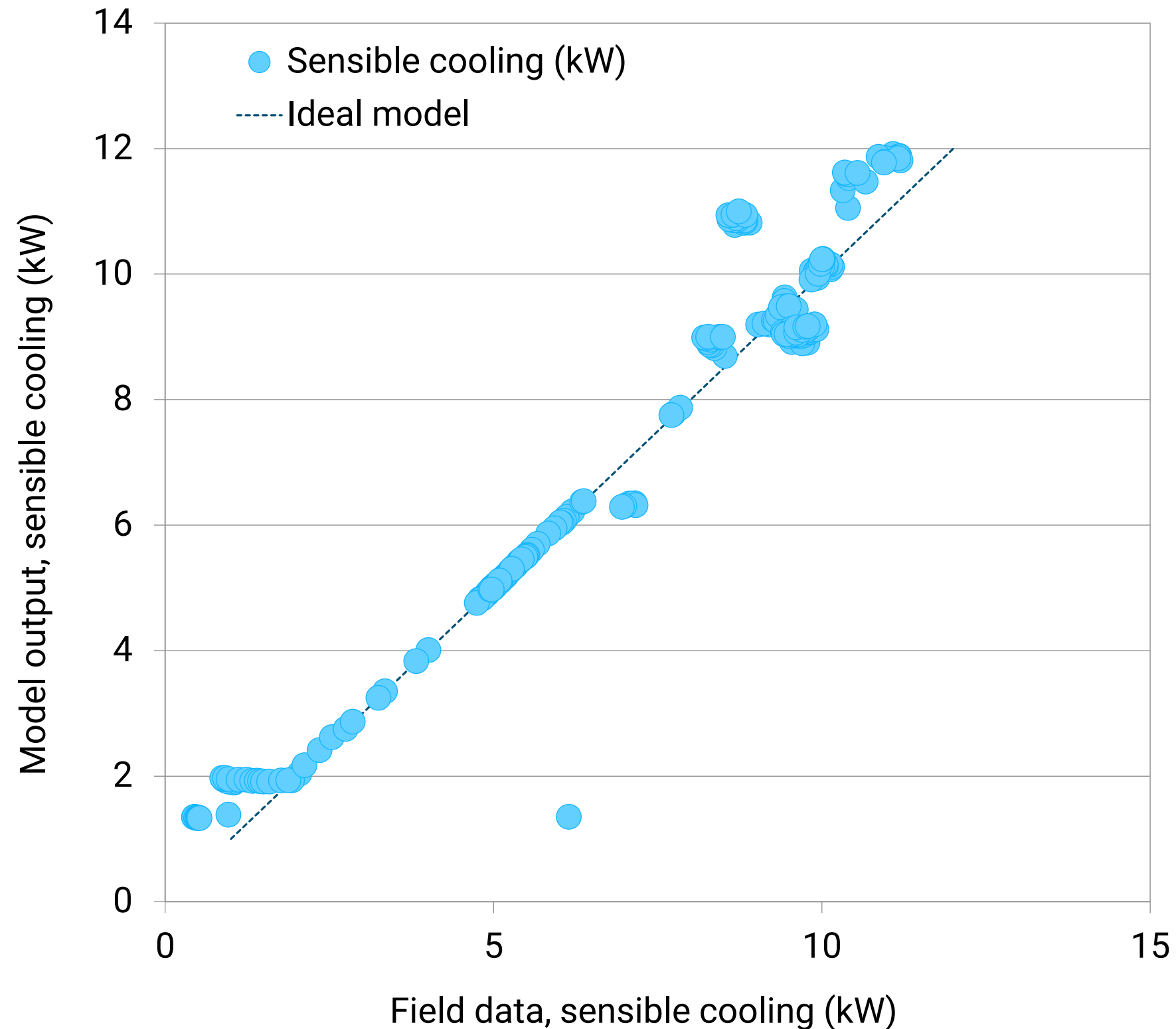
EnergyPlus Building Models for Pilot Testing

- » DOE sponsored undergraduate research program
- » Students collaborating with manufacturer partners
- » Manufacturers hosted students for internships
- » Each industry partner pilot testing model
 - Munters:
Retail with transfer air between zones
 - Integrated Comfort:
Large retail with multiple hybrid rooftop units
 - Seeley:
Conditioned warehouse and office space



DEPARTMENT OF ENERGY
**UNDERGRADUATE
RESEARCH FELLOWSHIP**
FOR ENERGY EFFICIENCY IN BUILDINGS

Model validation and next steps



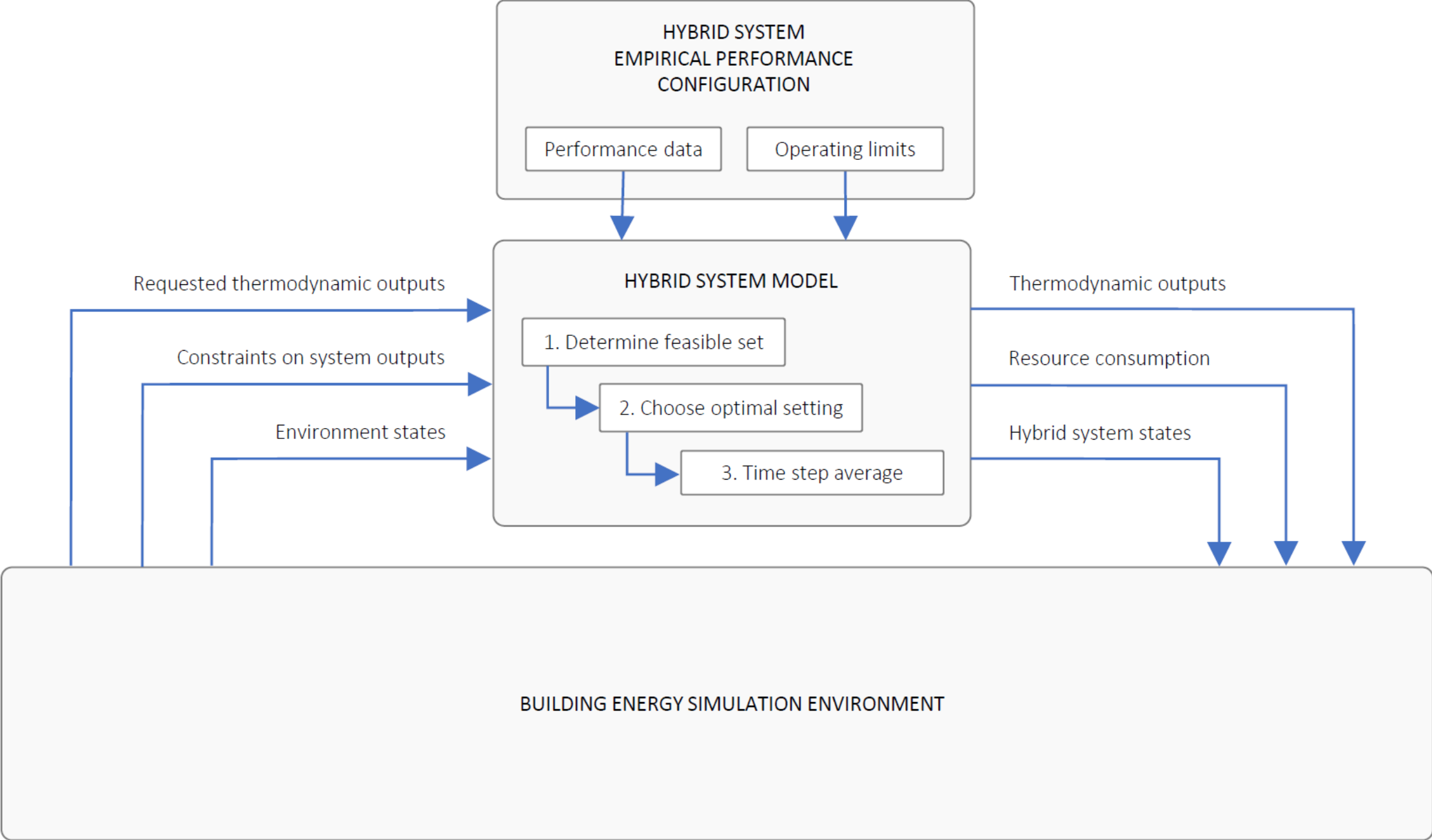
- » Proposing for EnergyPlus public release
- » Developing code tests
- » Developing example simulations
- » Developing documentation
- » Model validation in process
- » Developing final modeling structure
 - Lookup tables with polynomial interpolation
 - Partial runtime fraction
 - Custom control option
- » Pilot testing model to estimate energy savings for DualCool in multiple climate zones

Questions

Jonathan Woolley

jmwoolley@ucdavis.edu

(530) 204 7619



EnergyPlus inputs for “ZoneHVAC:HybridUnitaryHVAC”

Name		
Availability Schedule Name		
Availability Manager List Name		
Minimum Supply Air Humidity Ratio Schedule Name		
Maximum Supply Air Humidity Ratio Schedule Name		
Method to Choose Value of Controlled Inputs		
Method to determine part mode fraction		
Return Air Node Name		
Return air node for the hybrid unit		
Outside Air Node Name		
Supply Air Node Name		
Relief Node Name		
System Maximum Supply AirFlow Rate	m3/s	
External Static Pressure at System Max SA Flow	Pa	
Scaling Factor		
Number of Operating Modes		
Minimum Time Between Mode Change	Minutes	
First fuel type		
Second fuel type		
Third fuel type		
Objective Function Minimizes		

EnergyPlus inputs for each operating mode

Mode X Name		
Mode X Supply Air Temperature Lookup Table Name		
Mode X Supply Air Humidity Ratio Lookup Table Name		
Mode X System Electric Power Lookup Table Name		
Mode X Supply Fan Electric Power Lookup Table Name		
Mode X External Static Pressure Lookup Table Name		
Mode X System Second Fuel Consumption Lookup Table Name		
Mode X System Third Fuel Consumption Lookup Table Name		
Mode X System Water Use Lookup Table Name		
Mode X Minimum Outside Air Temperature	C	
Mode X Maximum Outside Air Temperature	C	
Mode X Minimum Outside Air Humidity Ratio	kgWater/kgDryAir	
Mode X Maximum Outside Air Humidity Ratio	kgWater/kgDryAir	
Mode X Minimum Outside Air Relative Humidity	%	
Mode X Maximum Outside Air Relative Humidity	%	
Mode X Minimum Return Air Temperature	C	
Mode X Maximum Return Air Temperature	C	
Mode X Minimum Return Air Humidity Ratio	kgWater/kgDryAir	
Mode X Maximum Return Air Humidity Ratio	kgWater/kgDryAir	
Mode X Minimum Return Air Relative Humidity	%	
Mode X Maximum Return Air Relative Humidity	%	