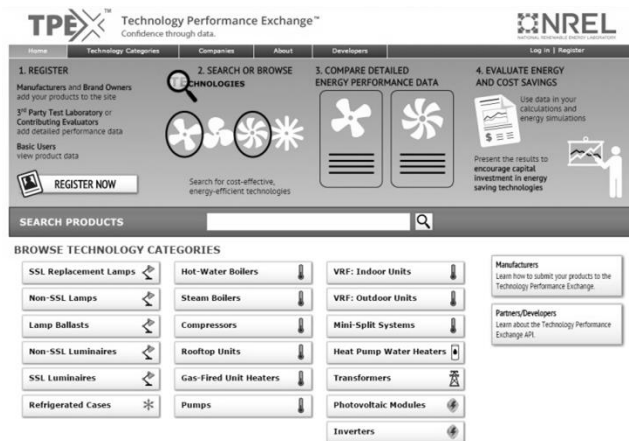




# EnergyPlus™ Building Energy Modeling Guide for LG Multi V™





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## Note

The EnergyPlus<sup>TM1</sup> Building Energy Modeling Guide for LG Multi V<sup>TM2</sup> contains step-by-step instructions to help users model LG Multi V systems. This modeling guide also includes engineering data from the Technology Performance Exchange<sup>TM3</sup> and the Building Component Library.

## Disclaimer

The EnergyPlus Building Energy Modeling Guide for LG Multi V is to be used for comparing systems and as a guideline only. Building load/energy has been approximated for modeling purposes or input value of equipment (capacity, power input, etc.), and results may vary depending on the situation. The conclusions of this Modeling Guide do not guarantee actual energy costs or savings.

This Modeling Guide is a design-and analysis guide to help designers optimize LG Multi V system design based on energy usage. Modeling accuracy is highly dependent on user-supplied data. It is the user's responsibility to understand how the entered data affects program output, and to understand that any predefined libraries are only guidelines for entering that data. The calculation results and reports from this guide are meant to aid the system designer and are not a substitute for design services, judgment, or experience.

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<sup>1</sup> EnergyPlus is a trademark of the United States Department of Energy.

<sup>2</sup> LG Multi V<sup>TM</sup> is a trademark of LG Electronics.

<sup>3</sup> Technology Performance Exchange<sup>TM</sup> (TPEX<sup>TM</sup>) is a trademark of the United States Department of Energy.



## 1. Introduction

EnergyPlus is a widely-used whole-building energy simulation program integrating building envelope, HVAC, water, and renewables. One of the notable features is that EnergyPlus has a VRF module and can model air and water source VRF systems.

OpenStudio® is an EnergyPlus-based building energy modeling program developed by the National Renewable Energy Laboratory (NREL) of the U.S. Department of Energy (DOE). OpenStudio performs building energy simulations in the stand-alone OpenStudio application or in the OpenStudio SketchUp plug-in.

Simulations with OpenStudio provide visualization of results, simple HVAC system designs, and a well-defined user interface. Importantly, OpenStudio uses a building component library (BCL), providing manufacturers' data for simulations. This manufacturer's data includes LG VRF systems.

## 2. LG VRF Data in TPEX™ and BCL

This chapter describes a modeling method for LG VRF systems in EnergyPlus and EnergyPlus-based building simulation programs.

### 2-A. Technology Performance Exchange (TPEX)

Technology Performance Exchange (TPEX) is a web-based tool used to share building-related product energy performance data between technology manufacturers, evaluators, utilities, modelers, researchers, and consumers. TPEX data defines product energy performance characteristics and helps users evaluate product energy use.

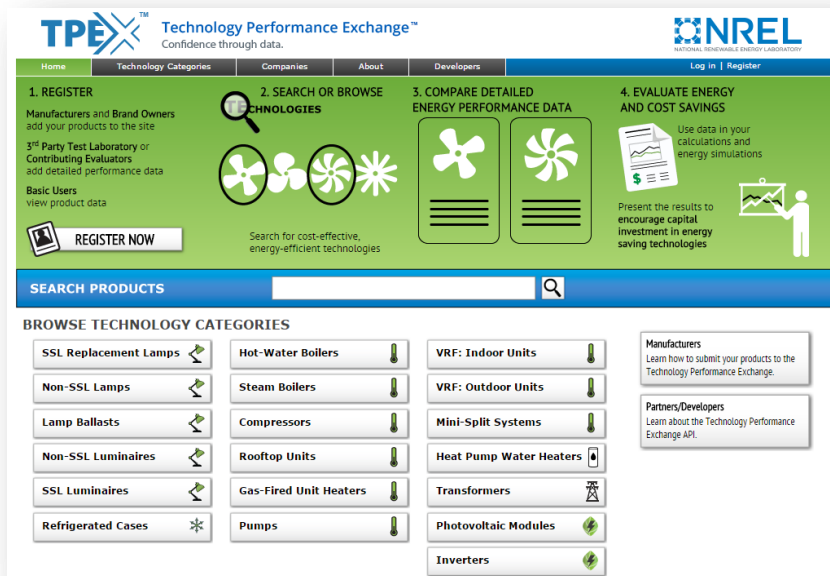


Figure 1: TPEX Main Page

The National Renewable Energy Laboratory (NREL) of the U.S. Department of Energy (DOE) developed TPEX with support from DOE's Federal Energy Management Program and the Building Technologies Office. In 2014, LG Electronics, USA worked with NREL as a TPEX launch partner. Since 2014, LG Electronics, USA has provided Multi V product engineering data for outdoor and indoor units.



### Project Summary

<p><b>Timeline:</b>          Start date: January 27, 2012          Planned end date: November 20, 2015</p> <p><b>Key Milestones</b>          1. Calibrated Energy Model; 5/22/15          2. BPA Sector Simulation; 10/16/15</p> <p><b>Budget:</b>          BTO \$ to date: \$769,000          FEMP \$ to date: \$565,000          Other \$ to date: \$323,759          Total future DOE \$: TBD</p> <p><b>Target Market/Audience:</b>          Utilities/implementers, commercial building owners, energy modelers, manufacturers</p>	<p><b>Key Partners:</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>DOE Federal Energy Management Program</td></tr> <tr><td>Bonneville Power Administration</td></tr> <tr style="border-bottom: 2px solid red;"><td>LG Electronics, USA</td></tr> </table> <p><b>Project Goal:</b>          Provides a pipeline for product-specific performance data submitted by manufacturers, utilities, and HIT Catalyst demonstrations to be quickly vetted, analyzed, and adopted by utilities and building owners.</p>	DOE Federal Energy Management Program	Bonneville Power Administration	LG Electronics, USA
DOE Federal Energy Management Program				
Bonneville Power Administration				
LG Electronics, USA				

Energy Efficiency & Renewable Energy

2

Figure 2: NREL-DOE TPEX 2015<sup>4</sup> Project Summary

Technology Performance Exchange™  
Confidence through data.

NATIONAL RENOVABLE ENERGY LABORATORY

Home Technology Categories Companies About Developers
BKwag Logout | My Account

**Results (84)** Results per page: 50

**Narrow Your Results**

**Data Contributed By:**

**Technology Category:**

Ductless Heat Pumps 84

Outdoor Unit 84

**Heat Recovery Capability:**

**Integrated Energy Efficiency Ratio ((BTU/h)/W):**

**Rated Cooling Coefficient Of Performance:**

**Rated Heating Capacity (W):**

**Rated Heating Coefficient Of Performance:**

**Rated Total Cooling Capacity (W):**

BRAND	PRODUCT LINE / FAMILY NAME	MODEL	Performance Data Highlights				COMPARE UP TO 4 PRODUCTS <small>Clear All</small>
			Rated Cooling Coefficient of Performance	Rated Heating Capacity (W)	Rated Heating Coefficient of Performance	Rated Total Cooling Capacity (W)	
LG Electronics USA	Multi V IV	ARUB168BTE4	3.47	55377	3.4	49224	<input type="checkbox"/>
			N/A	N/A	N/A	N/A	<input type="checkbox"/>
LG Electronics USA	Multi V IV	ARUB168DTE4	3.47	55377	3.4	49224	<input type="checkbox"/>
			N/A	N/A	N/A	N/A	<input type="checkbox"/>
LG Electronics USA	Multi V IV	ARUN192BTE4	3.62	63288	3.73	56256	<input type="checkbox"/>
			N/A	N/A	N/A	N/A	<input type="checkbox"/>
LG Electronics USA	Multi V IV	ARUN192DTE4	3.62	63288	3.73	56256	<input type="checkbox"/>
			N/A	N/A	N/A	N/A	<input type="checkbox"/>
LG Electronics USA	Multi V IV	ARUB192BTE4	3.62	63288	3.73	56256	<input type="checkbox"/>
			N/A	N/A	N/A	N/A	<input type="checkbox"/>

Figure 3: LG Multi V products in TPEX

<sup>4</sup> NREL-DOE Technology Performance Exchange, 2015 Building Technologies Office Peer Review, [http://energy.gov/sites/prod/files/2015/05/f22/cbi04\\_Studer\\_041515.pdf](http://energy.gov/sites/prod/files/2015/05/f22/cbi04_Studer_041515.pdf)

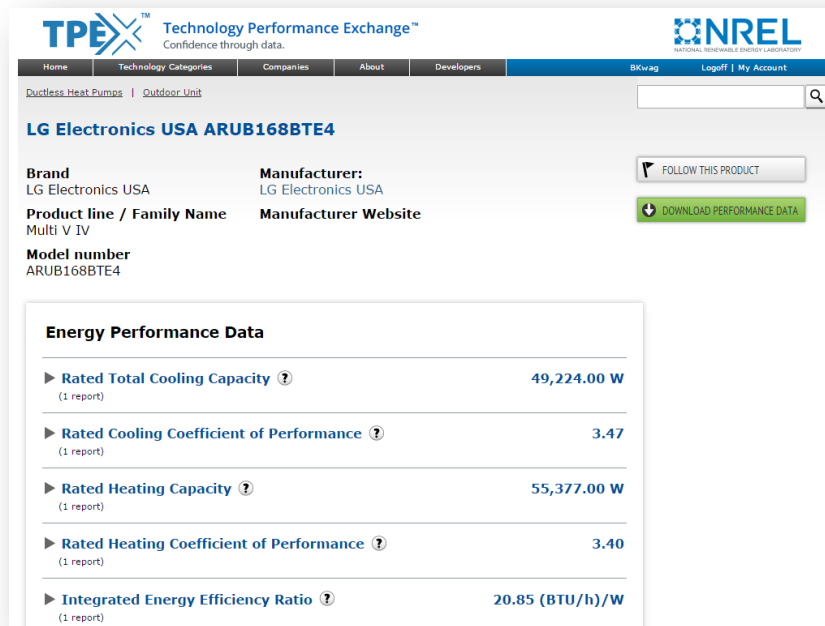


Figure 4: LG Multi V Detailed Information in TPEX

## 2-B. Building Component Library (BCL)

NREL's Building Component Library (BCL) is an online library of components for building energy modeling. The BCL gives building energy modelers and engineers convenient access to engineering data and transforms the data into engineering performance data required in building energy modeling tools.

The packaged information of TPEX building components data is provided through the DOE's BCL. This implies that since LG Electronics USA has been providing complete and accurate LG Multi V engineering data to TPEX since 2014, building energy modelers and engineers can use LG Multi V engineering data for their VRF projects through BCL. Currently, LG Electronics USA is leading the way in helping engineers, architectures and building owners identify energy efficient commercial air conditioning systems by providing VRF engineering data through TPEX and BCL (HVAC/P, 2014).

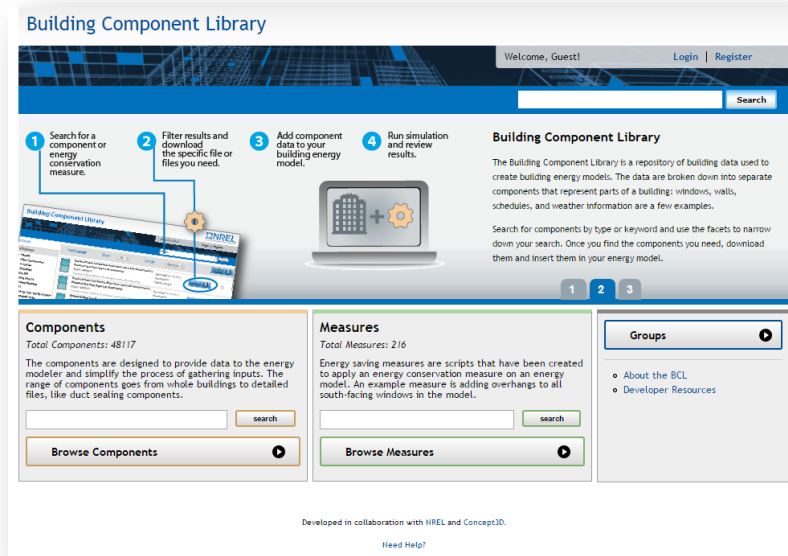


Figure 5: BCL Main Page

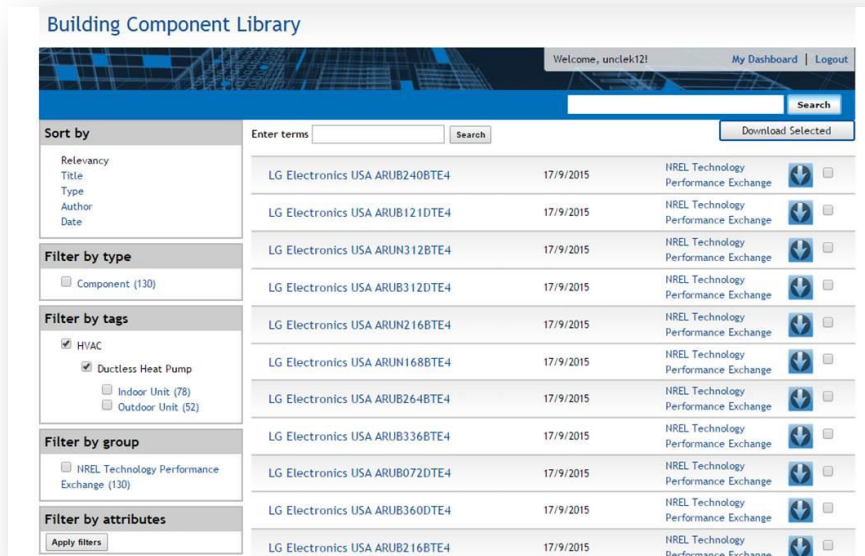


Figure 6: LG Multi V Products in BCL



### 3. Preparation

#### 3-A. Installation of Required Programs

- (1) EnergyPlus: Download the latest version of EnergyPlus (<https://EnergyPlus.net/downloads>).
- (2) SketchUp: Download the latest version of SketchUp ([www.sketchup.com](http://www.sketchup.com)).
- (3) OpenStudio:
  - Download the latest version of OpenStudio. (<https://www.openstudio.net/downloads>)
  - Install the downloaded OpenStudio. Then, OpenStudio application and OpenStudio SketchUp Plugin will be installed.

#### 3-B. BCL Setup in SketchUp (Optional)

Log-in to the Building Component Library (<https://bcl.nrel.gov>). If you don't have a BCL account, you can create one. Copy the text after API v1.1 key in "My Dashboard" near the top right of the website, and paste it to the menu 'Setup BCL Key' in SketchUp as shown in Figure 7 and Figure 8.

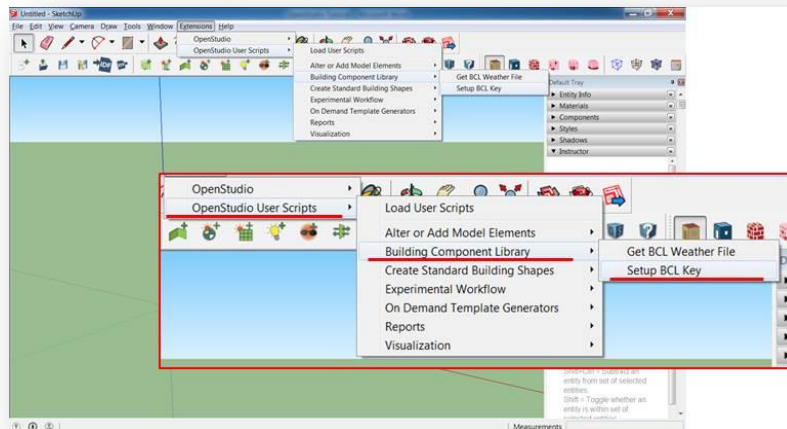


Figure 7: The BCL Key Setup Menu in the OpenStudio SketchUp Plug-in

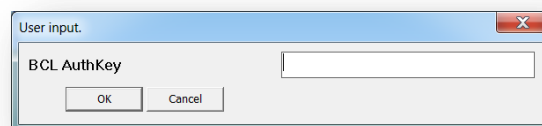



Figure 8: Enter the BCL Key in the OpenStudio SketchUp Plug-in

## 4. Building Energy Modeling

### 4-A. Modeling Building

Before beginning HVAC systems modeling in EnergyPlus and OpenStudio, define the building envelope, schedules, and interior loads. Building envelope can be modeled in three ways: (1) using SketchUp, (2) using EnergyPlus IDF Editor, and (3) using EnergyPlus Text Editor.

### 4-B. Modeling VRF Systems in OpenStudio

- (1) In OpenStudio, HVAC systems can be modeled in the 'HVAC Systems'  tab.
- (2) Click 'VRF' system on the drop-down list.

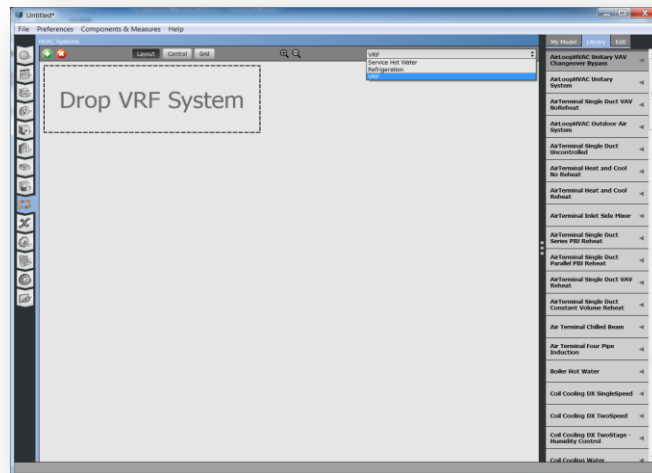


Figure 9: Setup HVAC Systems in OpenStudio

- (3) Click 'Find Components' under the 'Components & Measures' menu.

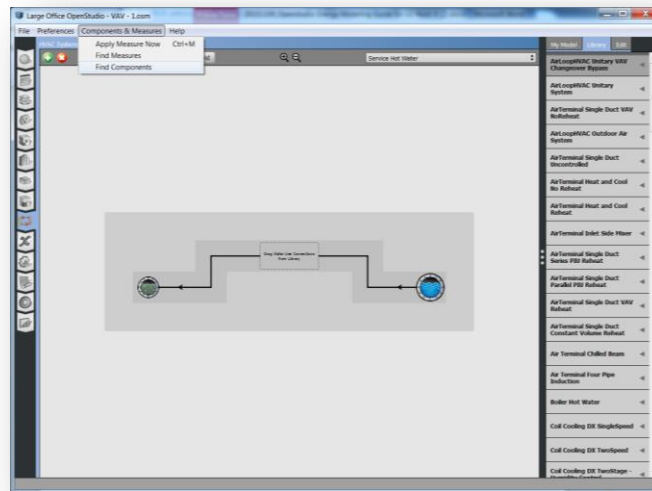


Figure 10: Using BCL data in OpenStudio

- (4) To import LG Multi V data from the BCL, select the 'HVAC' menu, and then select the 'Ductless Heat Pump' menu. Click 'Indoor Unit' or 'Outdoor Unit' in HVAC. LG Multi V products are displayed.

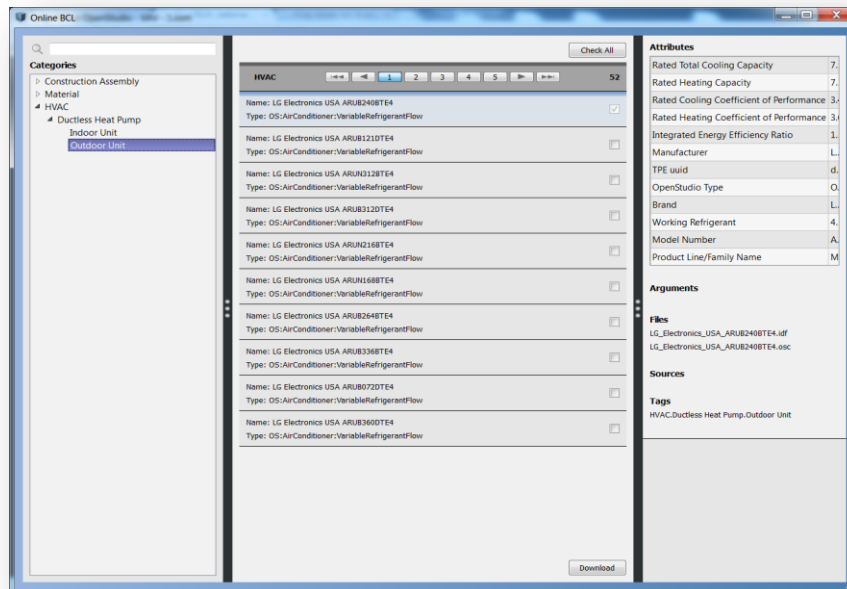


Figure 11: Online BCL for Downloading LG VRF Products



- (5) Select outdoor units and/or indoor units, and then click 'Download'. Close the 'Online BCL' window and go back to the OpenStudio application. The downloaded VRF systems appear in the right panel menu 'Library' with 'BCL' in blue.

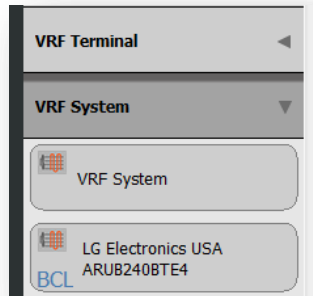


Figure 12: Downloaded LG VRF Products with 'BCL' in Blue

- (6) Locate the 'Library' menu on the right side of the VRF system window. Drag the outdoor unit downloaded from the BCL to the box 'Drop VRF System'. A new VRF system diagram appears.

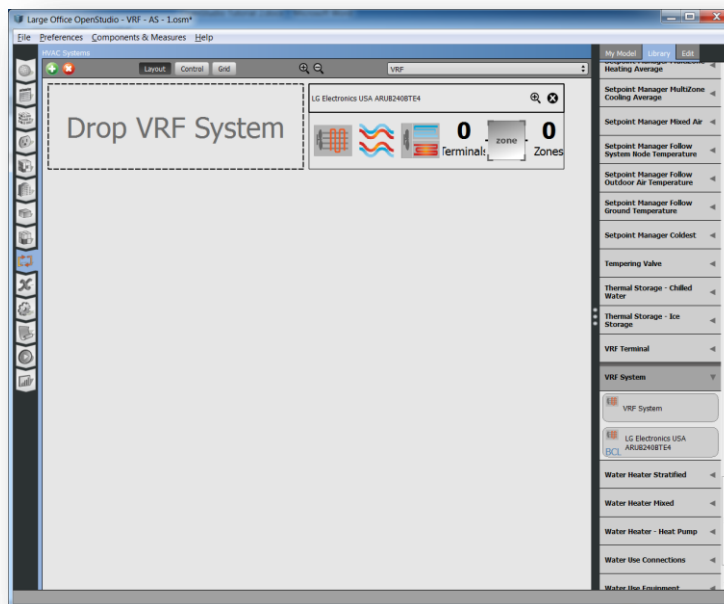


Figure 13: Diagrams of all VRF Systems Modeled in OpenStudio

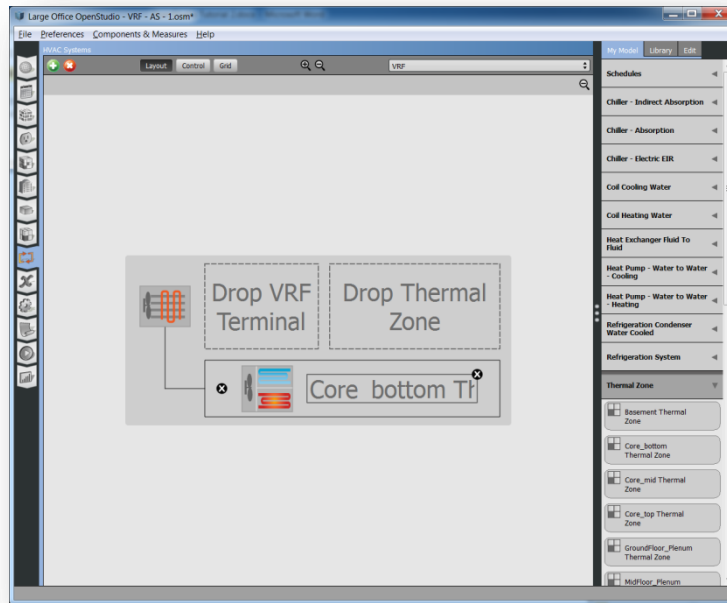



Figure 14: Detail Setup of a VRF system in OpenStudio

- (7) Click the zoom-in icon  to define detailed VRF systems including VRF Terminal units and thermal zones as shown in Figure 14.
- (8) Drag and drop the downloaded VRF Terminal unit from the right menu 'Library' to the 'Drop VRF Terminal' box.
- (9) Drag and drop a thermal zone from the 'Thermal Zone' under the right side tab 'My Model' to the 'Drop Thermal Zone' box.
- (10) When clicking outdoor units or indoor units in the VRF diagrams, the right panel menu 'Edit' displays, allowing modification of operation schedule and system specifications including capacities, flow rates, etc.
- (11) Go to the simulation tab, and perform a building energy simulation with the LG Multi V IV data.

#### 4-C. Modeling VRF Systems in EnergyPlus IDF-Editor

There are two methods of modeling in EnergyPlus; one is using the 'text editor', and the other is using the 'IDF editor'. You can also create detailed HVAC systems using templates or by adding each component individually. Users can use either way to model HVAC systems in EnergyPlus. This modeling guide uses the HVAC Template method for VRF systems for easy and quick modeling.

- (1) In your EnergyPlus IDF file, set up the following HVAC Templates:
  - HVACTemplate:Thermostat
  - HVACTemplate:Zone:VRF
  - HVACTemplate:System:VRF (define condensing type; air-cooled, water-cooled, or Evaporatively Cooled)
  - HVACTemplate:Plant:Tower, HVACTemplate:Plant:Boiler, and HVACTemplate:Plant:MixedWaterLoop (for water-source VRF outdoor unit models)
- (2) When running your IDF file with VRF HVAC Templates, the expand objects IDF file format (\*.expidf) is automatically generated in the same folder with the same file name.
- (3) Open the file in \*.expidf format with the IDF editor, and save as different name in \*.idf file format.
- (4) To model LG VRF products in EnergyPlus, use the Building Component Library developed by NREL for the product data library of LG VRF products.
- (5) Login to the Building Component Library (BCL, <https://bcl.nrel.gov>). Click “Browse Components”.

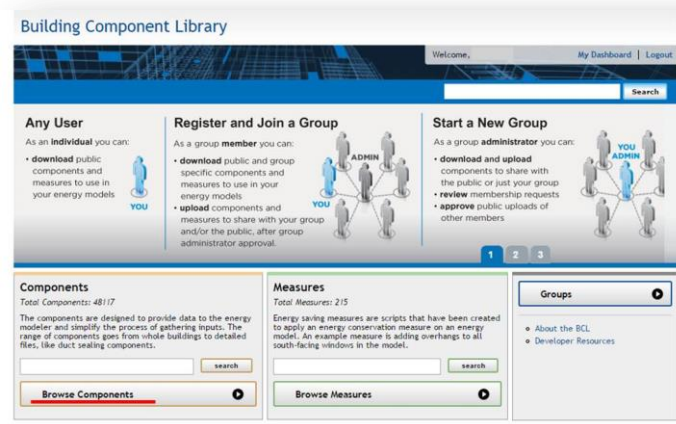


Figure 15: Click ‘Browse Components’ at the Building Component Library site

- (6) In the component library window, click ‘HVAC’ and select ‘Ductless Heat Pump’ in ‘Filter by tags’. The list of LG Multi V products is displayed.

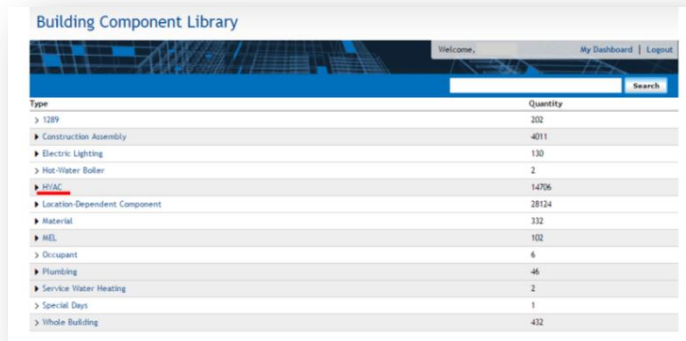


Figure 16: 'Browse Components' of BCL Screen

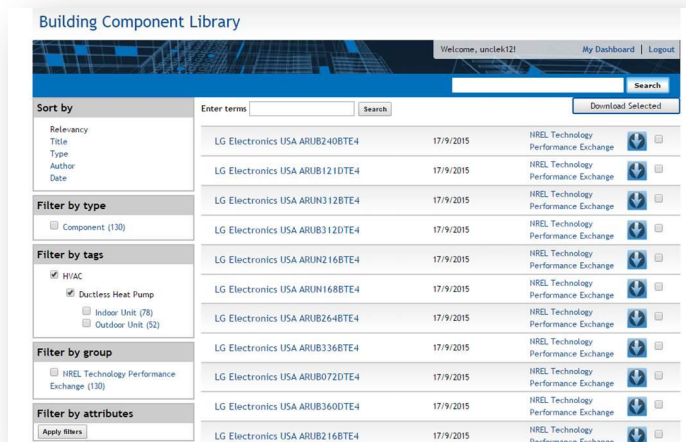


Figure 17: The list of LG VRF Products in BCL



(7) Find LG VRF outdoor units and indoor units, and download the selected product data in a zip file  component.zip by clicking the  icon. Unzip the downloaded file, then you will have two files in different formats for EnergyPlus and OpenStudio (\*.idf and \*.osc).<sup>5</sup>



Figure 18: The LG VRF outdoor unit and indoor unit in idf and osc formats

<sup>5</sup> **Note:** The file in idf format should be opened by EnergyPlus text editor or Notepad, not by the IDF editor. If you try to open the file in IDF Editor, you may have errors.



(8) The idf files of LG VRF outdoor and indoor units from BCL contain the following data. Copy these data and paste it in the idf file of your EnergyPlus model.

- **Outdoor units**

- Airconditioner:VariableRefrigerantFlow
- Performance Tables (representing performance curves)

- **Indoor units**

- ZoneHVAC:TerminalUnit:VariableRefrigerantFlow
- Coil:Cooling:DX:VariableRefrigerantFlow
- Coil:Heating:DX:VariableRefrigerantFlow
- Fan:ConstantVolume
- Performance Tables (representing performance curves)



## 5. Example Modeling in Energyplus

This example uses SketchUp and OpenStudio for building envelope and HVAC systems modeling, respectively. As shown in Figure 19, the sample building is a one-story, five-zone office building (W-100ft, L-50ft, H-9.8ft). Figure 20 shows the VRF systems connections for the five thermal zones of the sample building.

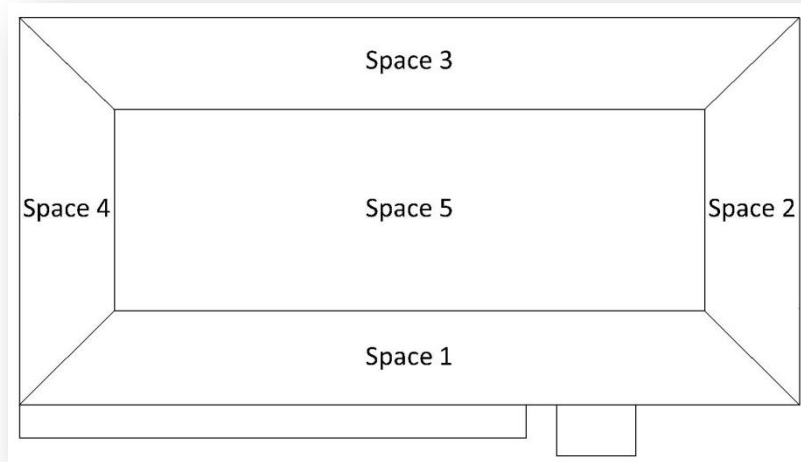


Figure 19: Schematic image of the example building

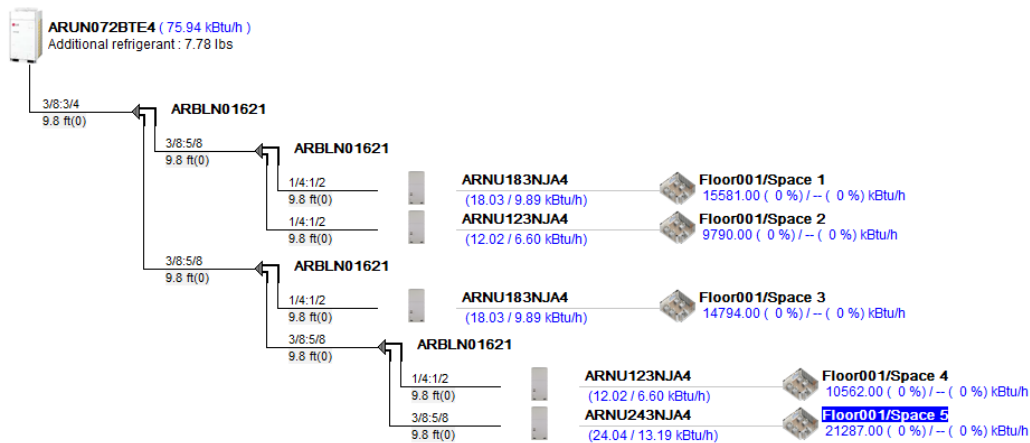



Figure 20: VRF Outdoor and Indoor Units Connections Example



Launch OpenStudio by clicking the OpenStudio icon  in SketchUp. Confirm that all inputs are correctly modeled, such as building envelope, schedules, equipment power and other building component information. For sizing VRF systems, the building's thermal loads must be estimated. As shown in Figure 21, select 'VRF Systems' in the right panel menu 'Library' and then drag and drop the box 'VRF Zone Terminal' to the box 'Drop VRF Terminal'. Assign a thermal zone for each VRF system.

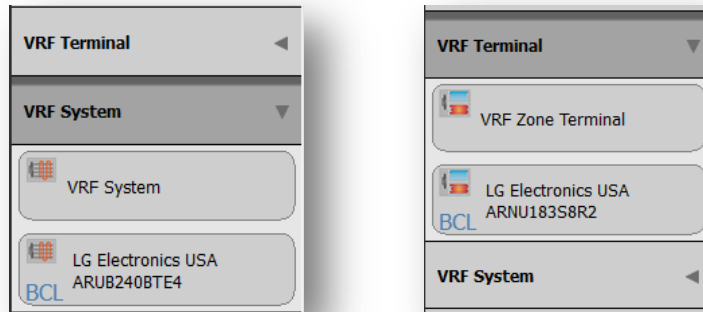


Figure 21: VRF System Setup for VRF Outdoor and Indoor Units

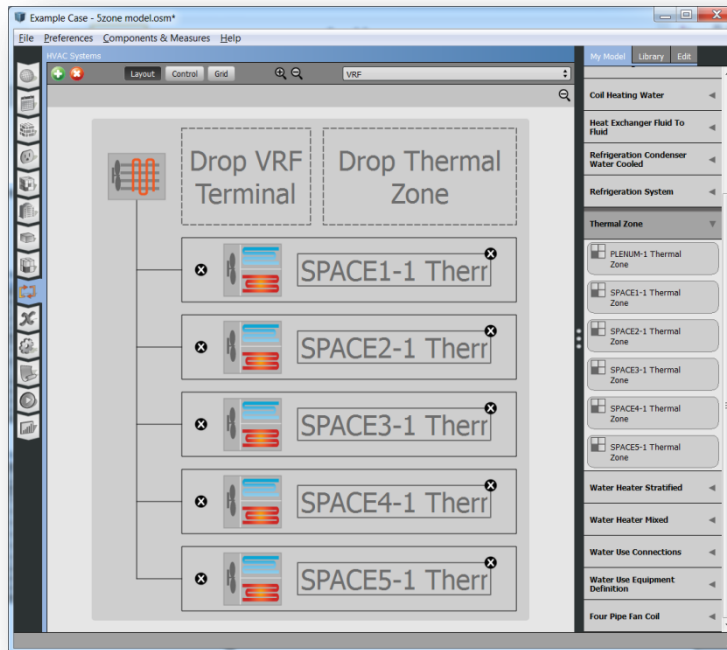


Figure 22: VRF System Connections for Thermal Zones

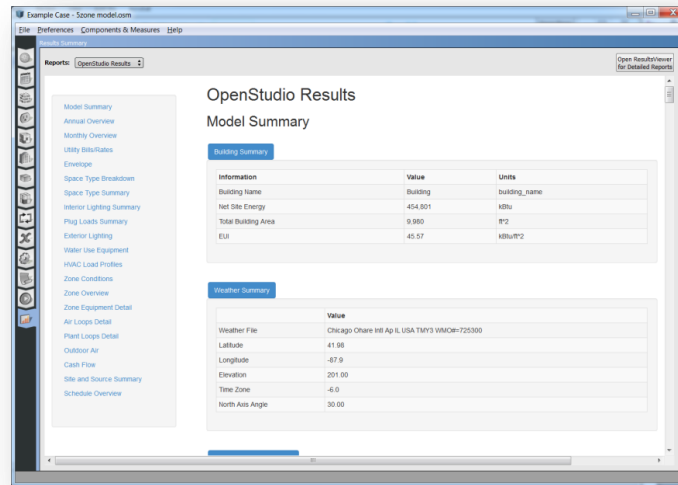


Figure 23: OpenStudio Results

As shown in Table 1, this example has a total cooling load of 72kBtu/h and total heating load of 70kBtu/h. VRF outdoor and indoor units can be chosen based on these results. Table 2 provides the details of the VRF system products selected to meet the building thermal loads.

Table 1: Thermal Loads of an Example Building Case

	Cooling load [Btu/h]	Heating load [Btu/h]
Space 1	15,581	19,075
Space 2	9,790	8,602
Space 3	14,794	18,824
Space 4	10,652	8,597
Space 5	21,287	15,356
Total	72,104	70,454

Table 2: LG VRF Systems to Meet the Thermal Loads of an Example Building

			Cooling capacity [Btu/h]	Heating capacity [Btu/h]
Outdoor unit		ARUN072BTE4	72,000	81,000
Indoor unit	Space 1	ARNU183NJA2	18,000	20,000
	Space 2	ARNU123NJA2	12,000	13,500
	Space 3	ARNU183NJA2	18,000	20,000
	Space 4	ARNU123NJA2	12,000	13,500
	Space 5	ARNU243NJA2	24,000	27,000
			Total	72,104

LG Multi V product engineering data can be downloaded from the BCL as depicted in Figure 24.

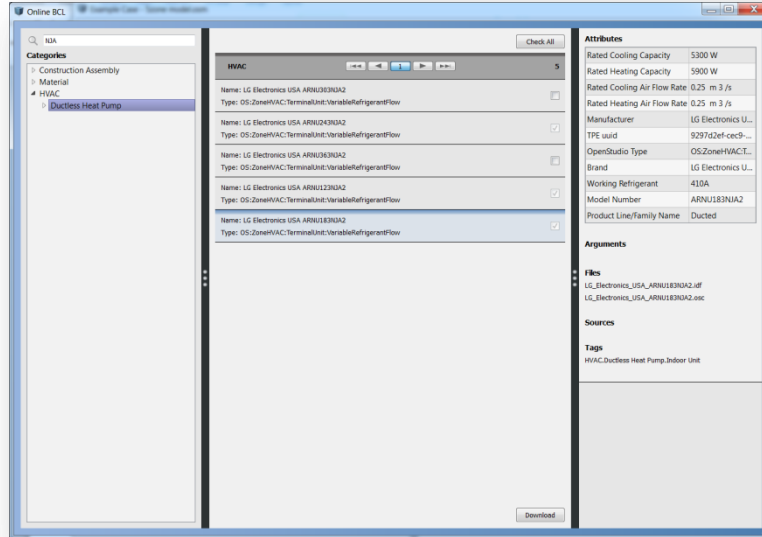


Figure 24: Download the Selected LG VRF Models from the Online BCL

The next step is VRF modeling using the selected LG Multi V products for the building thermal loads estimated from the baseline simulation.

In the 'HVAC Systems' window, delete the previously-made VRF systems and make a new VRF system. Click the right menu 'Library', and select 'VRF System'. Find the downloaded VRF system outdoor unit and drag and drop it to the box 'Drop VRF System'.

Define VRF Terminal units and thermal zones. In the right library, click 'VRF Terminal', and drag and drop the downloaded VRF indoor units to 'Drop VRF Terminal'. Assign the thermal zones as shown in Figure 25.

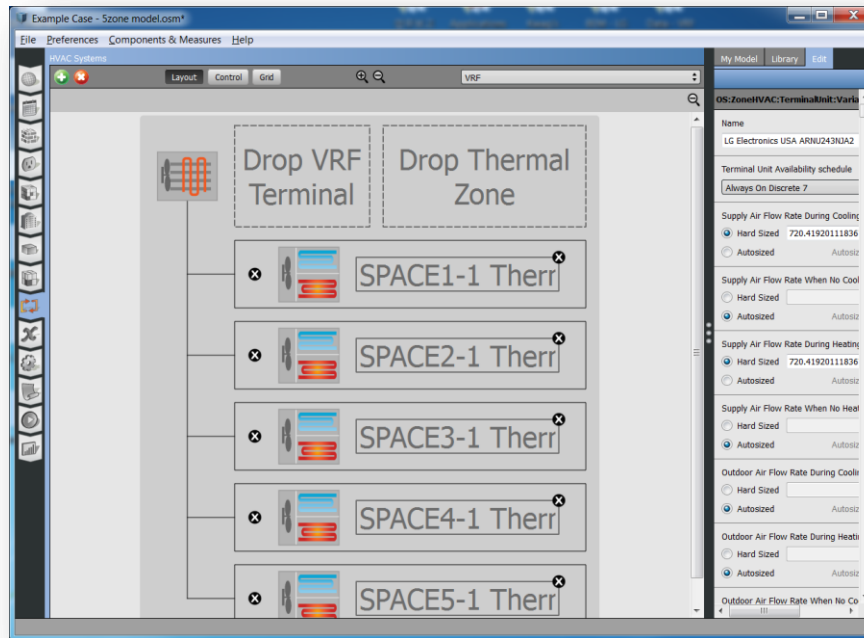


Figure 25: Detailed VRF System Setup with LG VRF Indoor Units for Thermal Zones

Before running the simulation, check if all inputs of the VRF outdoor and indoor units are correctly modeled based on the LG Multi V product engineering manuals and the EnergyPlus engineering manual.

For example, if the coil size inputs are out of the range of EnergyPlus limits, EnergyPlus<sup>6</sup> will generate an error and stop the simulation. The current EnergyPlus limit in cooling coil flow rate per capacity [cfm/ton or (m<sup>3</sup>/s)/W] is a maximum flow rate of 450 cfm/ton, which is 0.00006041 (m<sup>3</sup>/s)/Watt. Therefore, to avoid errors related to coil sizing issues, use the maximum coil flow rate of 450 cfm/ton (0.00006041 (m<sup>3</sup>/s)/Watt).

In this example case, the flow rate of ARNU123NJA2 model has 490 cfm/ton which is beyond the maximum limit. So, in this paper, the flow rate of ARNU123NJA2 model needs to be changed to meet the limit.

Table 3 and Table 4 provide OpenStudio inputs for VRF modeling. Appendix A of this guide contains detailed LG Multi V product information.

<sup>6</sup> Engineering Reference - The reference to EnergyPlus Calculations, 2015, EnergyPlus Documentation, v8.4.0



Table 3: Inputs of VRF Outdoor Unit Modeled in OpenStudio

Outdoor unit	Cooling capacity [Btu/h]	Heating capacity [Btu/h]	Efficiency	
			Cooling COP	Heating COP
ARUN072BTE4	72,000	81,000	4.83	4.73

Table 4: Inputs of VRF Indoor Units Modeled in OpenStudio

Indoor unit		Cooling capacity [Btu/h]	Heating capacity [Btu/h]	Flow rate per capacity	
				[CFM/Ton]	[m3/s/Watt]
Space 1	ARNU183NJA2	18,000	20,000	352	0.00004717
Space 2	ARNU123NJA2	12,000	13,500	<b>450</b>	0.00006041
Space 3	ARNU183NJA2	18,000	20,000	352	0.00004717
Space 4	ARNU123NJA2	12,000	13,500	<b>450</b>	0.00006041
Space 5	ARNU243NJA2	24,000	27,000	362	0.00004857
Total		72,104	70,454		

## 6. References

1. Engineering Reference - The reference to EnergyPlus Calculations, 2015, EnergyPlus Documentation, v8.4.0
2. OpenStudio 1.9.0 Basic Workflow Guide, 2015, <https://openstudio.net>
3. Building Component Library (BCL), <https://bcl.nrel.gov>
4. InterLab 2011, Building Component Library, [http://www.nrel.gov/ce/interlab2011/pdfs/bcl\\_interlab.pdf](http://www.nrel.gov/ce/interlab2011/pdfs/bcl_interlab.pdf)
5. Technology Performance Exchange™ Confidence through data (TPEx), <https://www.tpex.org>
6. NREL-DOE Technology Performance Exchange, 2015 Building Technologies Office Peer Review, [http://energy.gov/sites/prod/files/2015/05/f22/cbi04\\_Studer\\_041515.pdf](http://energy.gov/sites/prod/files/2015/05/f22/cbi04_Studer_041515.pdf)
7. NREL, The Technology Performance Exchange: An Overview and Update, <https://sftool.gov/Content/attachments/lswg/iswg-tools/3%20DanielStuder%20ElizaHotchkiss%20-%20TPEx%20Overview%20and%20Update.pdf>

### Articles on the TPEx and LG Multi V

8. Contracting Business.com, 2014, <http://contractingbusiness.com/commercial-hvac/lg-selected-doe-technology-exchange-program>
9. HVAC/P, 2014, <http://hvacproducts.com/2014/05/u-s-department-of-energys-new-technology-performance-exchange-program-selects-lg-electronics/>
10. Energy Manager Today, 2014, <http://www.energymanagertoday.com/lg-puts-air-conditioning-attributes-technology-exchange-0101043/>



# Appendix

## Engineering Inputs of LG Multi V Indoor Units and Modification of Flow Rate per Capacity

(Due to our continuous product innovation, the data may change without notice)

Type	Model	Capacity [kBtu/h]		Capacity [W]		TPEX Flow Rate Per Capacity		Modified Flow Rate Per Capacity	
		Cooling	Heating	Cooling	Heating	CFM /Ton	m <sup>3</sup> /s/Watt	CFM /Ton	m <sup>3</sup> /s/Watt
Art Cool Mirror	ARNU093SER2	10	11	2800	3200	346	0.00004643	346	0.00004643
	ARNU073SER2	8	9	2200	2500	406	0.00005455	406	0.00005455
	ARNU123SER2	12	14	3600	4000	352	0.00004722	352	0.00004722
	ARNU183S8R2	19	21	5600	6300	279	0.00003750	279	0.00003750
	ARNU153SER2	15	17	4500	5000	298	0.00004000	298	0.00004000
	ARNU243S8R2	24	27	7100	8000	262	0.00003521	262	0.00003521
Ceiling Cassettes	ARNU053TRC2	5	6	1600	1800	605	0.00008125	450	0.00008125
	ARNU073TJC2	8	9	2200	2500	440	0.00005909	440	0.00005909
	ARNU093TJC2	10	11	2800	3200	346	0.00004643	346	0.00004643
	ARNU093TRC2	10	11	2800	3200	346	0.00004643	346	0.00004643
	ARNU093TPAA	10	11	2800	3200	532	0.00007143	450	0.00007143
	ARNU123TPAA	12	14	3600	4000	455	0.00006111	450	0.00006111
	ARNU123TRC2	12	14	3600	4000	290	0.00003889	290	0.00003889
	ARNU123TJC2	12	14	3600	4000	269	0.00003611	269	0.00003611
	ARNU153TPAA	15	17	4500	5000	447	0.00006000	447	0.00006000
	ARNU153TQC2	15	17	4500	5000	298	0.00004000	298	0.00004000
	ARNU183TLC2	19	21	5600	6300	293	0.00003929	293	0.00003929
	ARNU183TNAA	19	21	5600	6300	359	0.00004821	359	0.00004821
	ARNU183TQC2	19	21	5600	6300	253	0.00003393	253	0.00003393
	ARNU243TLC2	24	27	7100	8000	294	0.00003944	294	0.00003944
	ARNU243TNAA	24	27	7100	8000	367	0.00004930	367	0.00004930
	ARNU243TPC2	24	27	7100	8000	294	0.00003944	294	0.00003944
	ARNU283TPC2	28	31	8200	9200	254	0.00003415	254	0.00003415
	ARNU363TNC2	36	41	10600	11900	295	0.00003962	295	0.00003962
	ARNU423TMC2	42	47	12300	13800	303	0.00004065	303	0.00004065
	ARNU483TMC2	48	54	14100	15900	275	0.00003688	275	0.00003688
ARNU093VEA2	10	11	2800	3200	346	0.00004643	346	0.00004643	





Type	Model	Capacity [kBtu/h]		Capacity [W]		TPEX Flow Rate Per Capacity		Modified Flow Rate Per Capacity	
		Cooling	Heating	Cooling	Heating	CFM /Ton	m <sup>3</sup> /s/Watt	CFM /Ton	m <sup>3</sup> /s/Watt
Convertible Surface Mount	ARNU123VEA2	12	14	3600	4000	311	0.00004167	311	0.00004167
	ARNU183VJA2	19	21	5600	6300	359	0.00004821	359	0.00004821
	ARNU243VJA2	24	27	7100	8000	315	0.00004225	315	0.00004225
Ducted	ARNU073B1G2	8	9	2200	2500	474	0.00006364	450	0.00006364
	ARNU073BHA2	8	9	2200	2500	406	0.00005455	406	0.00005455
	ARNU073B3G2	8	9	2200	2500	440	0.00005909	440	0.00005909
	ARNU093B3G2	10	11	2800	3200	399	0.00005357	399	0.00005357
	ARNU093BHA2	10	11	2800	3200	399	0.00005357	399	0.00005357
	ARNU093B1G2	10	11	2800	3200	426	0.00005714	426	0.00005714
	ARNU123NJA2	12	13	3500	3900	490	0.00006571	450	0.00006571
	ARNU123BHA2	12	14	3600	4000	414	0.00005556	414	0.00005556
	ARNU123B1G2	12	14	3600	4000	373	0.00005000	373	0.00005000
	ARNU123B3G2	12	14	3600	4000	352	0.00004722	352	0.00004722
	ARNU153B3G2	15	17	4500	5000	298	0.00004000	298	0.00004000
	ARNU153BHA2	15	17	4500	5000	381	0.00005111	381	0.00005111
	ARNU153BGA2	15	17	4500	5000	381	0.00005111	381	0.00005111
	ARNU153B1G2	15	17	4500	5000	315	0.00004222	315	0.00004222
	ARNU183NJA2	18	20	5300	5900	352	0.00004717	352	0.00004717
	ARNU183BGA2	19	21	5600	6300	333	0.00004464	333	0.00004464
	ARNU183B4G2	19	21	5600	6300	306	0.00004107	306	0.00004107
	ARNU183B2G2	19	21	5600	6300	359	0.00004821	359	0.00004821
	ARNU183BHA2	19	21	5600	6300	346	0.00004643	346	0.00004643
	ARNU243NJA2	24	27	7000	7900	362	0.00004857	362	0.00004857
	ARNU243B2G2	24	27	7100	8000	336	0.00004507	336	0.00004507
	ARNU243BGA2	24	27	7100	8000	336	0.00004507	336	0.00004507
	ARNU243B4G2	24	27	7100	8000	294	0.00003944	294	0.00003944
	ARNU243BHA2	24	27	7100	8000	315	0.00004225	315	0.00004225
	ARNU283BGA2	28	31	8200	9200	382	0.00005122	382	0.00005122
	ARNU303NJA2	30	34	8800	10000	356	0.00004773	356	0.00004773
	ARNU363BGA2	36	41	10600	11900	380	0.00005094	380	0.00005094
	ARNU363NJA2	36	40	10600	11700	366	0.00004906	366	0.00004906
ARNU423BGA2	42	47	12300	13800	345	0.00004634	345	0.00004634	
ARNU423NKA2	42	46	12300	13500	357	0.00004797	357	0.00004797	
ARNU483NKA2	48	54	14100	15800	349	0.00004681	349	0.00004681	
ARNU483BRA2	48	54	14100	15900	396	0.00005319	396	0.00005319	
ARNU543BRA2	54	61	15800	18000	401	0.00005380	401	0.00005380	



Type	Model	Capacity [kBtu/h]		Capacity [W]		TPEX Flow Rate Per Capacity		Modified Flow Rate Per Capacity	
		Cooling	Heating	Cooling	Heating	CFM /Ton	m <sup>3</sup> /s/Watt	CFM /Ton	m <sup>3</sup> /s/Watt
	ARNU543NKA2	54	60	15800	17600	330	0.00004430	330	0.00004430
	ARNU763B8A2	76	86	22400	25200	333	0.00004464	333	0.00004464
	ARNU963B8A2	96	107	28000	31500	319	0.00004286	319	0.00004286
Floor Standing	ARNU073CEA2	8	9	2200	2500	474	0.00006364	450	0.00006364
	ARNU093CEA2	10	11	2800	3200	426	0.00005714	426	0.00005714
	ARNU123CEA2	12	14	3600	4000	373	0.00005000	373	0.00005000
	ARNU153CEA2	15	17	4500	5000	315	0.00004222	315	0.00004222
	ARNU183CFA2	19	21	5600	6300	359	0.00004821	359	0.00004821
	ARNU243CFA2	24	27	7100	8000	315	0.00004225	315	0.00004225
Wall Mount	ARNU073SEL2	8	9	2200	2500	305	0.00004091	305	0.00004091
	ARNU093SEL2	10	11	2800	3200	319	0.00004286	319	0.00004286
	ARNU123SEL2	12	14	3600	4000	331	0.00004444	331	0.00004444
	ARNU153SEL2	15	17	4500	5000	298	0.00004000	298	0.00004000
	ARNU183S5L2	19	21	5600	6300	266	0.00003571	266	0.00003571
	ARNU243S5L2	24	27	7100	8000	241	0.00003239	241	0.00003239



## Engineering Inputs of LG Multi V Outdoor Units

(Due to our continuous product innovation, the data may change without notice)

Model	Cooling Capacity [W]	Heating Capacity [W]	Cooling Capacity [kBtu/h]	Heating Capacity [kBtu/h]	Cooling Power Input [kW]	Heating Power Input [kW]	TPEX Efficiency		Nominal Efficiency	
							Cooling COP	Heating COP	Cooling COP	Heating COP
ARUN072BTE4	21096	23733	72	81	4.37	5.02	4.03	4.05	4.83	4.73
ARUN072DTE4	21096	23733	72	81	4.37	5.02	4.03	4.05	4.83	4.73
ARUB072BTE4	21096	23733	72	81	4.37	5.02	4.03	4.05	4.83	4.73
ARUB072DTE4	21096	23733	72	81	4.37	5.02	4.03	4.05	4.83	4.73
ARUN096BTE4	28128	31644	96	108	5.76	6.76	4.03	3.98	4.88	4.68
ARUN096DTE4	28128	31644	96	108	5.76	6.76	4.03	3.98	4.88	4.68
ARUB096BTE4	28128	31644	96	108	5.76	6.76	4.03	3.98	4.88	4.68
ARUB096DTE4	28128	31644	96	108	5.76	6.76	4.03	3.98	4.88	4.68
ARUN121BTE4	35160	39555	120	135	7.83	9.21	3.82	3.7	4.49	4.29
ARUN121DTE4	35160	39555	120	135	7.83	9.21	3.82	3.7	4.49	4.29
ARUB121BTE4	35160	39555	120	135	7.83	9.21	3.82	3.7	4.49	4.29
ARUB121DTE4	35160	39555	120	135	7.83	9.21	3.82	3.7	4.49	4.29
ARUN144BTE4	42192	47466	144	162	9.64	10.85	3.54	3.65	4.38	4.37
ARUN144DTE4	42192	47466	144	162	9.64	10.85	3.54	3.65	4.38	4.37
ARUB144BTE4	42192	47466	144	162	9.64	10.85	3.54	3.65	4.38	4.37
ARUB144DTE4	42192	47466	144	162	9.64	10.85	3.54	3.65	4.38	4.37
ARUN168BTE4	49224	55377	168	189	12.26	14.27	3.47	3.4	4.02	3.88
ARUN168DTE4	49224	55377	168	189	12.26	14.27	3.47	3.4	4.02	3.88
ARUB168BTE4	49224	55377	168	189	12.26	14.27	3.47	3.4	4.02	3.88
ARUB168DTE4	49224	55377	168	189	12.26	14.27	3.47	3.4	4.02	3.88
ARUN192BTE4	56256	63288	192	216	12.20	14.23	3.62	3.73	4.61	4.45
ARUN192DTE4	56256	63288	192	216	12.20	14.23	3.62	3.73	4.61	4.45
ARUB192BTE4	56256	63288	192	216	12.20	14.23	3.62	3.73	4.61	4.45
ARUB192DTE4	56256	63288	192	216	12.20	14.23	3.62	3.73	4.61	4.45
ARUN216BTE4	63288	71199	216	243	14.01	15.87	3.54	3.69	4.52	4.49
ARUN216DTE4	63288	71199	216	243	14.01	15.87	3.51	3.69	4.52	4.49
ARUB216BTE4	63288	71199	216	243	14.01	15.87	3.54	3.69	4.52	4.49
ARUB216DTE4	63288	71199	216	243	14.01	15.87	3.54	3.69	4.52	4.49
ARUN240BTE4	70320	79110	240	270	15.40	17.61	3.48	3.61	4.57	4.49
ARUN240DTE4	70320	79110	240	270	15.40	17.61	3.48	3.61	4.57	4.49
ARUB240BTE4	70320	79110	240	270	15.40	17.61	3.46	3.61	4.57	4.49
ARUB240DTE4	70320	79110	240	270	15.40	17.61	3.46	3.61	4.57	4.49
ARUN264BTE4	77352	87021	264	297	17.47	20.06	3.37	3.46	4.43	4.34
ARUN264DTE4	77352	87021	264	297	17.47	20.06	3.37	3.46	4.43	4.34
ARUB264BTE4	77352	87021	264	297	17.47	20.06	3.37	3.46	4.43	4.34
ARUB264DTE4	77352	87021	264	297	17.47	20.06	3.37	3.46	4.43	4.34



Model	Cooling Capacity [W]	Heating Capacity [W]	Cooling Capacity [kBtu/h]	Heating Capacity [kBtu/h]	Cooling Power Input [kW]	Heating Power Input [kW]	TPEX Efficiency		Nominal Efficiency	
							Cooling COP	Heating COP	Cooling COP	Heating COP
ARUN288BTE4	84384	94932	288	324	19.28	21.70	3.34	3.41	4.38	4.37
ARUN288DTE4	84384	94932	288	324	19.28	21.70	3.34	3.41	4.38	4.37
ARUB288BTE4	84384	94932	288	324	19.28	21.70	3.34	3.41	4.38	4.37
ARUB288DTE4	84384	94932	288	324	19.28	21.70	3.34	3.41	4.38	4.37
ARUN312BTE4	91416	102843	312	351	19.77	22.63	3.3	3.43	4.62	4.54
ARUN312DTE4	91416	102843	312	351	19.77	22.63	3.3	3.43	4.62	4.54
ARUB312BTE4	91416	102843	312	351	19.77	22.63	3.3	3.43	4.62	4.54
ARUB312DTE4	91416	102843	312	351	19.77	22.63	3.3	3.43	4.62	4.54
ARUN336BTE4	98448	110754	336	378	21.16	24.37	3.21	3.39	4.65	4.54
ARUN336DTE4	98448	110754	336	378	21.16	24.37	3.21	3.39	4.65	4.54
ARUB336BTE4	98448	110754	336	378	21.16	24.37	3.21	3.39	4.65	4.54
ARUB336DTE4	98448	110754	336	378	21.16	24.37	3.21	3.39	4.65	4.54
ARUN360BTE4	105480	118665	360	405	23.23	26.82	3.15	3.4	4.54	4.42
ARUN360DTE4	105480	118665	360	405	23.23	26.82	3.15	3.4	4.54	4.42
ARUB360BTE4	105480	118665	360	405	23.23	26.82	3.15	3.4	4.54	4.42
ARUB360DTE4	105480	118665	360	405	23.23	26.82	3.15	3.38	4.54	4.42