Modelling of buildings and solar systems with EnergyPlus

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Content (75min)

- AA EnergyPlus (15 min)?
- BB How to model Buildings by E+ (30 min)?
- CC How to model Solar systems by E+ (30 min)?

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AA1 BASICs
AA2 PROVIDING INFORMATION TO E+
AA3 RUNING SIMULATION

AA ENERGY+

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AA1 BASICS

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1 WHAT IS ENERGYPLUS

- EnergyPlus is a building energy simulation program for modeling building heating, cooling, lighting, and ventilation.
- It includes solar collector systems, and photovoltaic systems.

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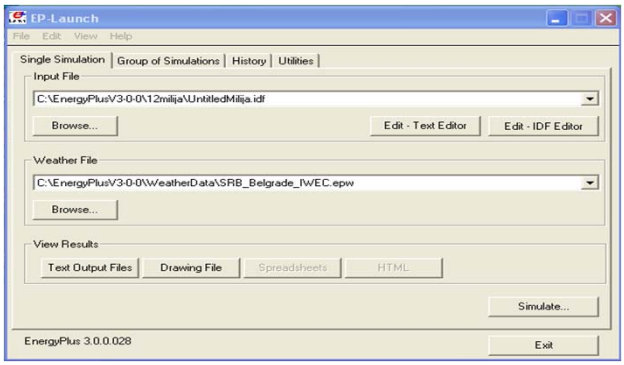
2 Ep-lunch



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3 DOWNLOAD AND INSTALL EnergyPlus

- Download and install the latest version of EnergyPlus from: http://apps1.eere.energy.gov/buildings/energyplus/register.cfm
- This is version: 8.1.0.
- The operative system is Windows, Mac, Linux.

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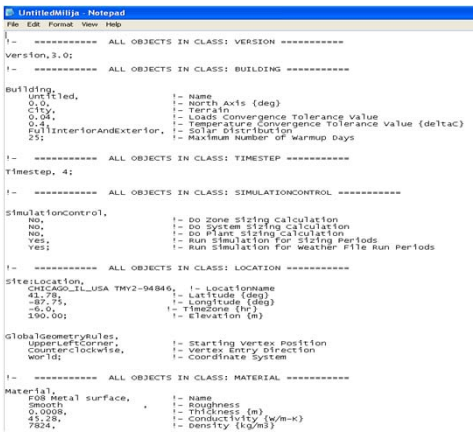
4 Reads and writes as text files

- It is a stand-alone simulation program without a 'user friendly' graphical inter-face. It reads input and writes output as text files.



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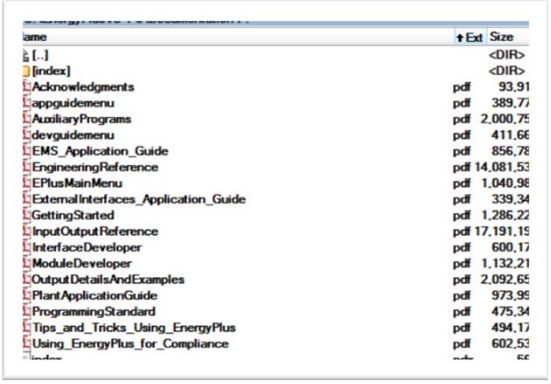
5 DOCUMENTATION

- For more information on any step please refer to the E+ documentation that comes with the installation.



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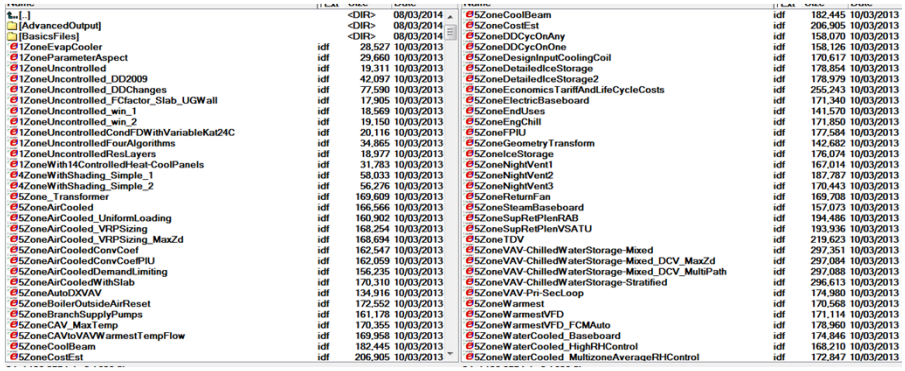
devguidemenu	pdf	411,66
EMS_Application_Guide	pdf	856,78
EngineeringReference	pdf	14,081,53
EPlusMainMenu	pdf	1,040,98
ExternalInterfaces_Application_Guide	pdf	339,34
GettingStarted	pdf	1,286,22
InputOutputReference	pdf	17,191,19
InterfaceDeveloper	pdf	600,17
ModuleDeveloper	pdf	1,132,21
OutputDetailsAndExamples	pdf	2,092,65
PlantApplicationGuide	pdf	973,99
ProgrammingStandard	pdf	475,34
Tips_and_Tricks_Using_EnergyPlus	pdf	494,17
Using_EnergyPlus_for_Compliance	pdf	602,53

6 Examples



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1ZoneParameterAspect	idf	29,660	10/03/2013
1ZoneUncontrolled	idf	19,311	10/03/2013
1ZoneUncontrolled_DD2009	idf	42,097	10/03/2013
1ZoneUncontrolled_DDChanges	idf	77,590	10/03/2013
1ZoneUncontrolled_FCfactor_Slab_UGWall	idf	17,905	10/03/2013
1ZoneUncontrolled_win_1	idf	18,569	10/03/2013
1ZoneUncontrolled_win_2	idf	19,150	10/03/2013
1ZoneUncontrolledCondFDWithVariableKat24C	idf	20,116	10/03/2013
1ZoneUncontrolledFourAlgorithms	idf	34,865	10/03/2013
1ZoneUncontrolledResLayers	idf	18,977	10/03/2013
1ZoneWithHCControlledHeat-CoolPanels	idf	31,783	10/03/2013
4ZoneWithShading_Simple_1	idf	58,033	10/03/2013
4ZoneWithShading_Simple_2	idf	56,276	10/03/2013
5Zone_Transformer	idf	169,609	10/03/2013
5ZoneAirCooled	idf	166,566	10/03/2013
5ZoneAirCooled_UniformLoading	idf	160,902	10/03/2013
5ZoneAirCooled_VRPSizing	idf	168,254	10/03/2013
5ZoneAirCooled_VRPSizing_MaxZd	idf	168,694	10/03/2013
5ZoneAirCooledConvCoef	idf	162,547	10/03/2013
5ZoneAirCooledConvCoefPIU	idf	162,059	10/03/2013
5ZoneAirCooledDemandLimiting	idf	156,235	10/03/2013
5ZoneAirCooledWithSlab	idf	170,310	10/03/2013
5ZoneAutoDXVAV	idf	134,916	10/03/2013
5ZoneBoilerOutsideAirReset	idf	172,552	10/03/2013
5ZoneBranchSupplyPumps	idf	161,178	10/03/2013
5ZoneCAV_MaxTemp	idf	170,355	10/03/2013
5ZoneCAVtoVAVWarmestTempFlow	idf	169,958	10/03/2013
5ZoneCoolBeam	idf	182,445	10/03/2013
5ZoneCostEst	idf	206,905	10/03/2013
5ZoneCoolBeam	idf	182,445	10/03/2013
5ZoneCostEst	idf	206,905	10/03/2013
5ZoneDDCycOnAny	idf	158,070	10/03/2013
5ZoneDDCycOnOne	idf	158,126	10/03/2013
5ZoneDesignInputCoolingCoil	idf	170,617	10/03/2013
5ZoneDetailedIceStorage	idf	178,854	10/03/2013
5ZoneDetailedIceStorage2	idf	178,979	10/03/2013
5ZoneEconomicsTariffAndLifeCycleCosts	idf	255,243	10/03/2013
5ZoneElectricBaseboard	idf	171,340	10/03/2013
5ZoneEndUses	idf	141,570	10/03/2013
5ZoneEngChill	idf	171,850	10/03/2013
5ZoneFPIU	idf	177,584	10/03/2013
5ZoneGeometryTransform	idf	142,682	10/03/2013
5ZoneIceStorage	idf	176,074	10/03/2013
5ZoneNightVent1	idf	167,014	10/03/2013
5ZoneNightVent2	idf	187,787	10/03/2013
5ZoneNightVent3	idf	170,443	10/03/2013
5ZoneReturnFan	idf	169,708	10/03/2013
5ZoneSteamBaseboard	idf	157,073	10/03/2013
5ZoneSupRetPlenRAB	idf	194,486	10/03/2013
5ZoneSupRetPlenVSATU	idf	193,936	10/03/2013
5ZoneTDV	idf	219,623	10/03/2013
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5ZoneVAV-ChilledWaterStorage-Mixed_DCV_MaxZd	idf	297,084	10/03/2013
5ZoneVAV-ChilledWaterStorage-Mixed_DCV_MultiPath	idf	297,088	10/03/2013
5ZoneVAV-ChilledWaterStorage-Stratified	idf	296,613	10/03/2013
5ZoneVAV-Pri-SecLoop	idf	174,980	10/03/2013
5ZoneWarmest	idf	170,568	10/03/2013
5ZoneWarmestVFD	idf	171,114	10/03/2013
5ZoneWarmestVFD_FCMAuto	idf	178,960	10/03/2013
5ZoneWaterCooled_Baseboard	idf	174,846	10/03/2013
5ZoneWaterCooled_HighRHControl	idf	168,210	10/03/2013
5ZoneWaterCooled_MultizoneAverageRHControl	idf	172,847	10/03/2013

ExampleFiles.xls; ExampleFiles-ObjectsLink.xls

7 SUPPORT GROUPS

- If some unresolved issue will be encountered during work with EnergyPlus, the support group can be found in http://tech.groups.yahoo.com/group/EnergyPlus_Support/ and http://energyplus.helpserve.com/.

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8. Weather data

- It includes time steps of less than an hour
- Weather data for more than 2100 locations are now available in EnergyPlus weather format — 1042 locations in the USA, 71 locations in Canada, and more than 1000 locations in 100 other countries throughout the world.
- http://apps1.eere.energy.gov/buildings/energyplus/weatherdata_about.cfm
- Meteonorm_Weather_Files
- https://groups.yahoo.com/neo/groups/EnergyPlus_Support/files/Meteonorm_Weather_Files/

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9. Different versions

Windows - Programs for converting older version IDF files to current (or intermediate) versions

- http://energyplus.helpserve.com/Knowledgebase/Article/View/86/47/windows---programs-for-converting-older-version-idf-files-to-current-or-intermediate-versions

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10. Testing and Validation

- http://apps1.eere.energy.gov/buildings/energyplus/energyplus_testing.cfm

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AA2 PROVIDING INFORMATION TO E+

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1 EDITING (idf files)

- The input file (*.idf) can be created or edited
- either by using a user interface (IDF Editor) which comes with EnergyPlus installation,
- or in a simple text editor (like as notepad),
- or by using OpenStudio that goes with Google Sketch-up.

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2 IDF EDITOR

For users who want a simple way of creating or editing EnergyPlus input data files (IDF), IDF Editor provides this service. Any EnergyPlus object may be viewed and edited using a spreadsheet-like grid.

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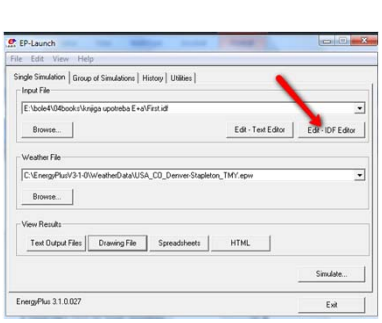
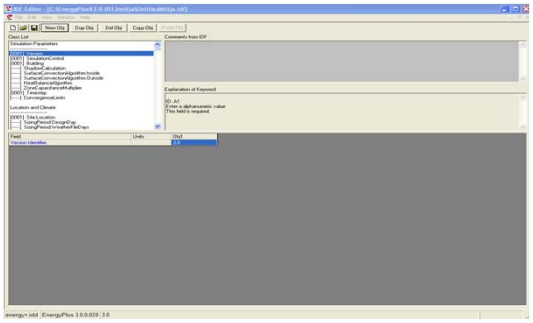
3 IDF file inside the IDF Editor





- You can take a look into IDF editor and explore basic things that you input into editor.

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4 IDF EDITOR -list

For inputs with several options, a list is provided. When a numeric input has a range of valid values, those values are displayed. It also automatically provides a list of object names when an object needs to be linked to another. By displaying all objects of the same kind next to each other in a grid, it is easy to see how inputs are different across the building

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5 IDF EDITOR –comments and validity

The IDF Editor outputs an EnergyPlus input file with proper syntax and comments to help the user understand the input values. In addition, the IDF Editor converts standard inch-pound units into SI units compatible with EnergyPlus.

- The IDF Editor does not check inputs for validity, although some numeric fields are highlighted if out of range.

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6 Text EDITOR of the IDF file

- If you would like to correct EnergyPlus code by using text, start „edit text editor“ button of „input file“ of Energyplus.

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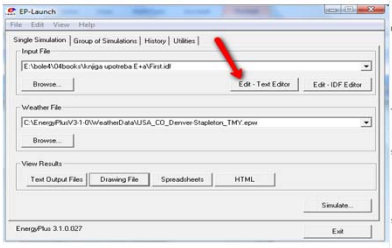
7 IDF file inside the text EDITOR



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8 OpenStudio with Google Legacy Sketch-up

- Google Sketch-up. http://www.sketchup.com/products/sketchup-make
- **Legacy OpenStudio Plug-in for SketchUp**

http://apps1.eere.energy.gov/buildings/energyplus/openstudio.cfm

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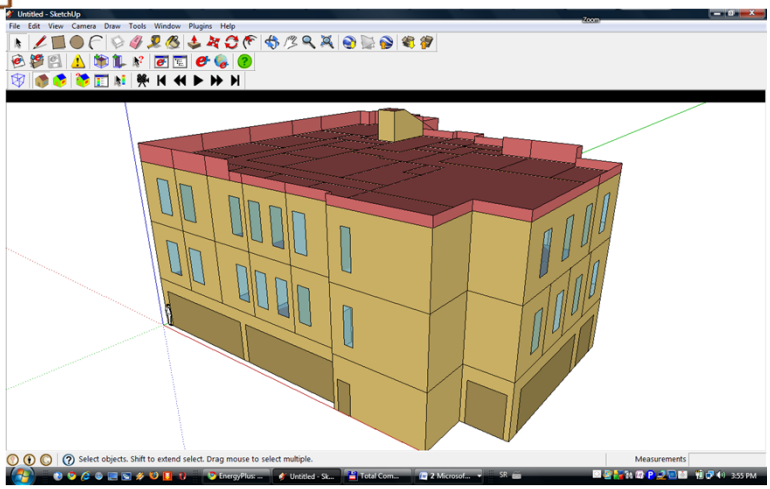

Building geometry provided by OpenStudio for EnergyPlus

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AA3 RUNING SIMULATION

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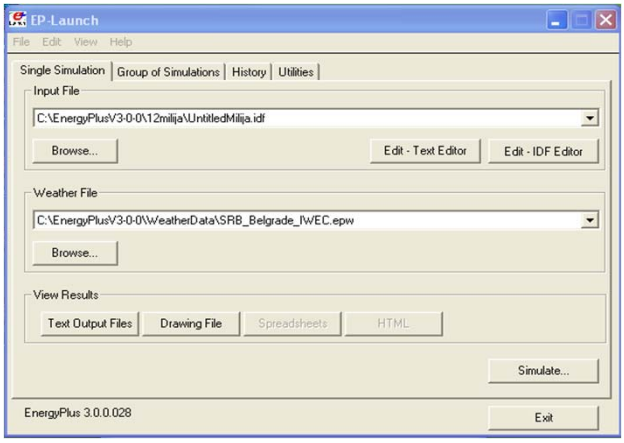
1 Start Ep-lunch



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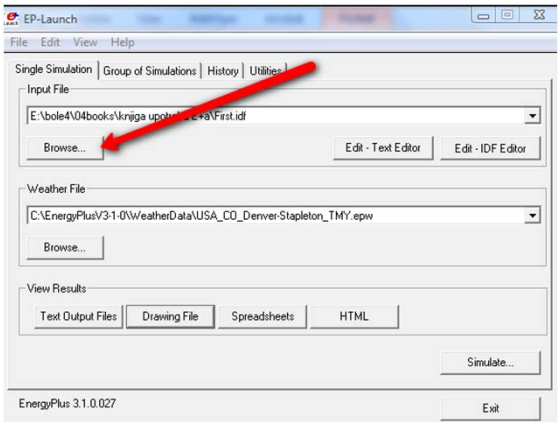
2 Find an input file (First.idf)



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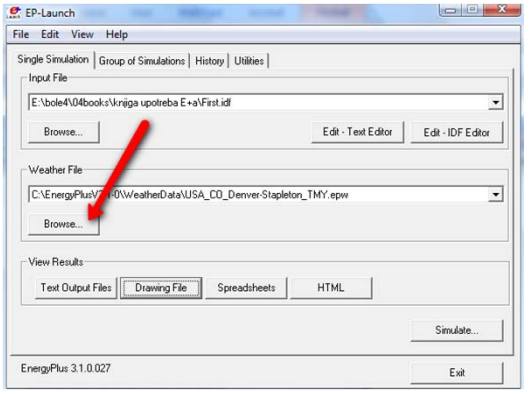
3 Find a weather file (USA_CO_DenverStapleton_TMY.epw)



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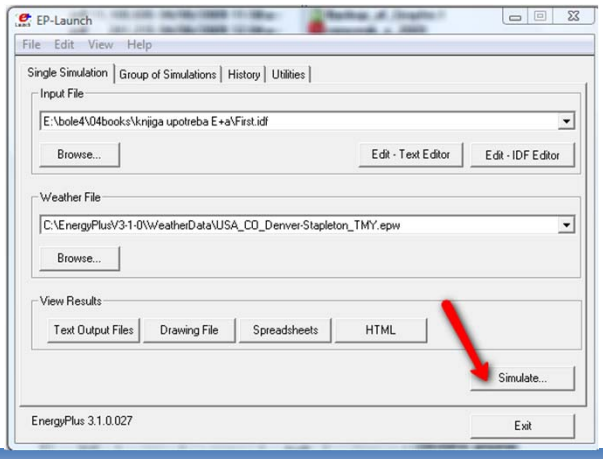
4 Start a simulation and wait EnergyPlus to finish this simulation.



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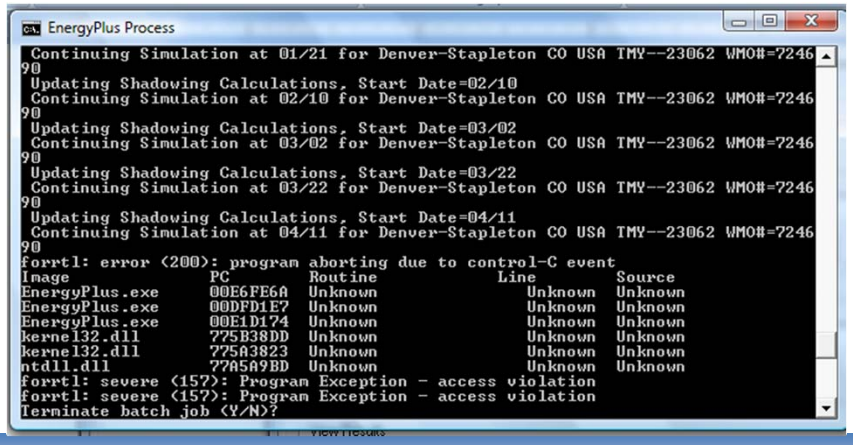
5 Simulation Run



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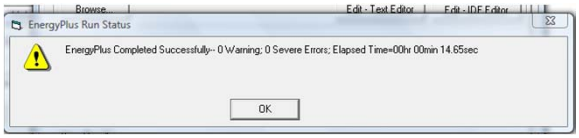
6 Run Status



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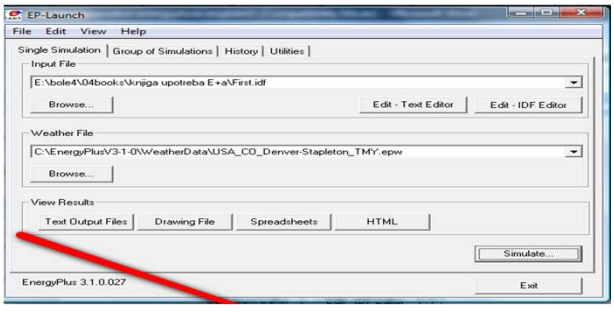
7 Quick open panel for single simulation



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8.1 Text output files

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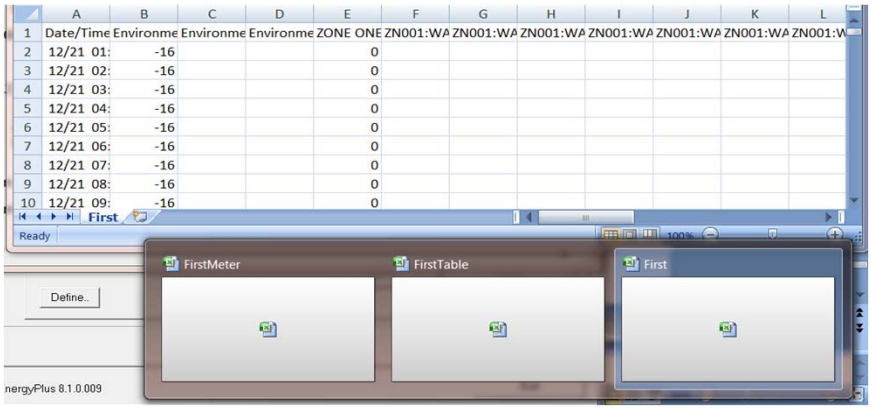
8.2 Spreadsheets



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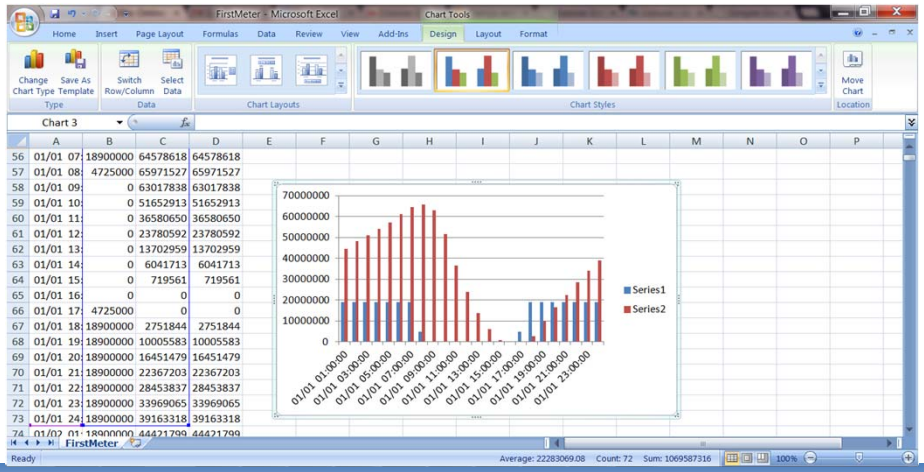
8.2 Spreadsheets and charts



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8.3 HTLM output content

Table of Contents

Top
Annual Building Utility Performance Summary
Input Verification and Results Summary
Demand End Use Components Summary
Source Energy End Use Components Summary
Component Sizing Summary
Surface Shadowing Summary
Climatic Data Summary
Envelope Summary
Shading Summary
Lighting Summary
Equipment Summary
HVAC Sizing Summary
System Summary
Outdoor Air Summary
Object Count Summary
Energy Meters
Sensible Heat Gain Summary
LEED Summary

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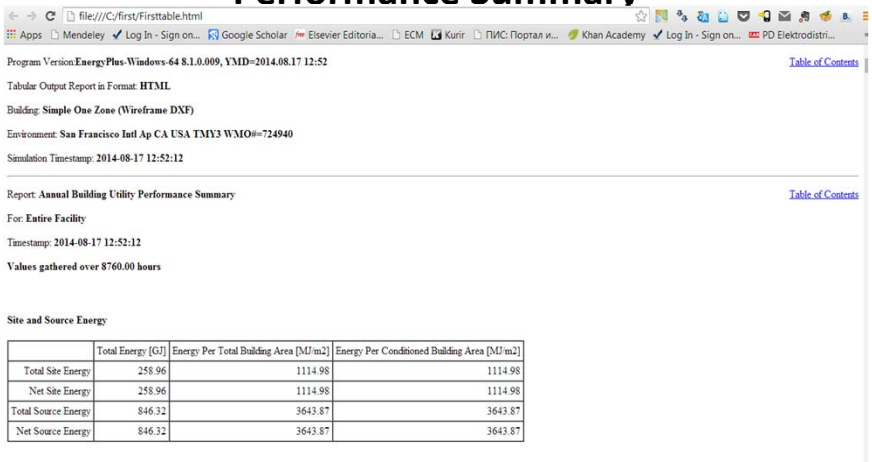
8.3 HTLM output **Annual Building Utility Performance Summary**



file:///C:/first/Firsttable.html

Program Version:**EnergyPlus-Windows-64 8.1.0.009, YMD=2014.08.17 12:52** Table of Contents

Tabular Output Report in Format: **HTML**

Building: **Simple One Zone (Wireframe DXF)**

Environment: **San Francisco Intl Ap CA USA TMY3 WMO#=724940**

Simulation Timestamp: **2014-08-17 12:52:12**

Report: **Annual Building Utility Performance Summary** Table of Contents

For: **Entire Facility**

Timestamp: **2014-08-17 12:52:12**

Values gathered over 8760.00 hours

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	258.96	1114.98	1114.98
Net Site Energy	258.96	1114.98	1114.98
Total Source Energy	846.32	3643.87	3643.87
Net Source Energy	846.32	3643.87	3643.87

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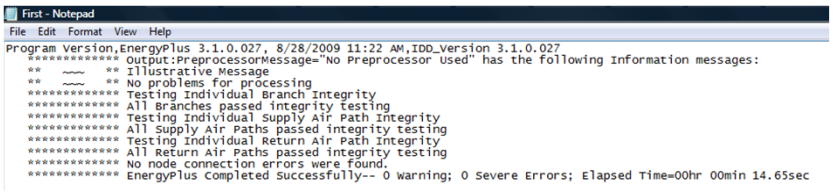
8 Err file



First - Notepad

File Edit Format View Help

```
Program Version,EnergyPlus 3.1.0.027, 8/28/2009 11:22 AM,IDD_Version 3.1.0.027
   ************* Output:PreprocessorMessage="No Preprocessor Used" has the following Information messages:
   **    ~~~   ** Illustrative Message
   **    ~~~   ** No problems for processing
   ************* Testing Individual Branch Integrity
   ************* All Branches passed integrity testing
   ************* Testing Individual Supply Air Path Integrity
   ************* All Supply Air Paths passed integrity testing
   ************* Testing Individual Return Air Path Integrity
   ************* All Return Air Paths passed integrity testing
   ************* No node connection errors were found.
   ************* EnergyPlus Completed Successfully-- 0 Warning; 0 Severe Errors; Elapsed Time=00hr 00min 14.65sec
```

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