CABEC
2014 Conference

October 10, 2014

CBECC-Com

California Building Energy Code Compliance for Commercial Buildings

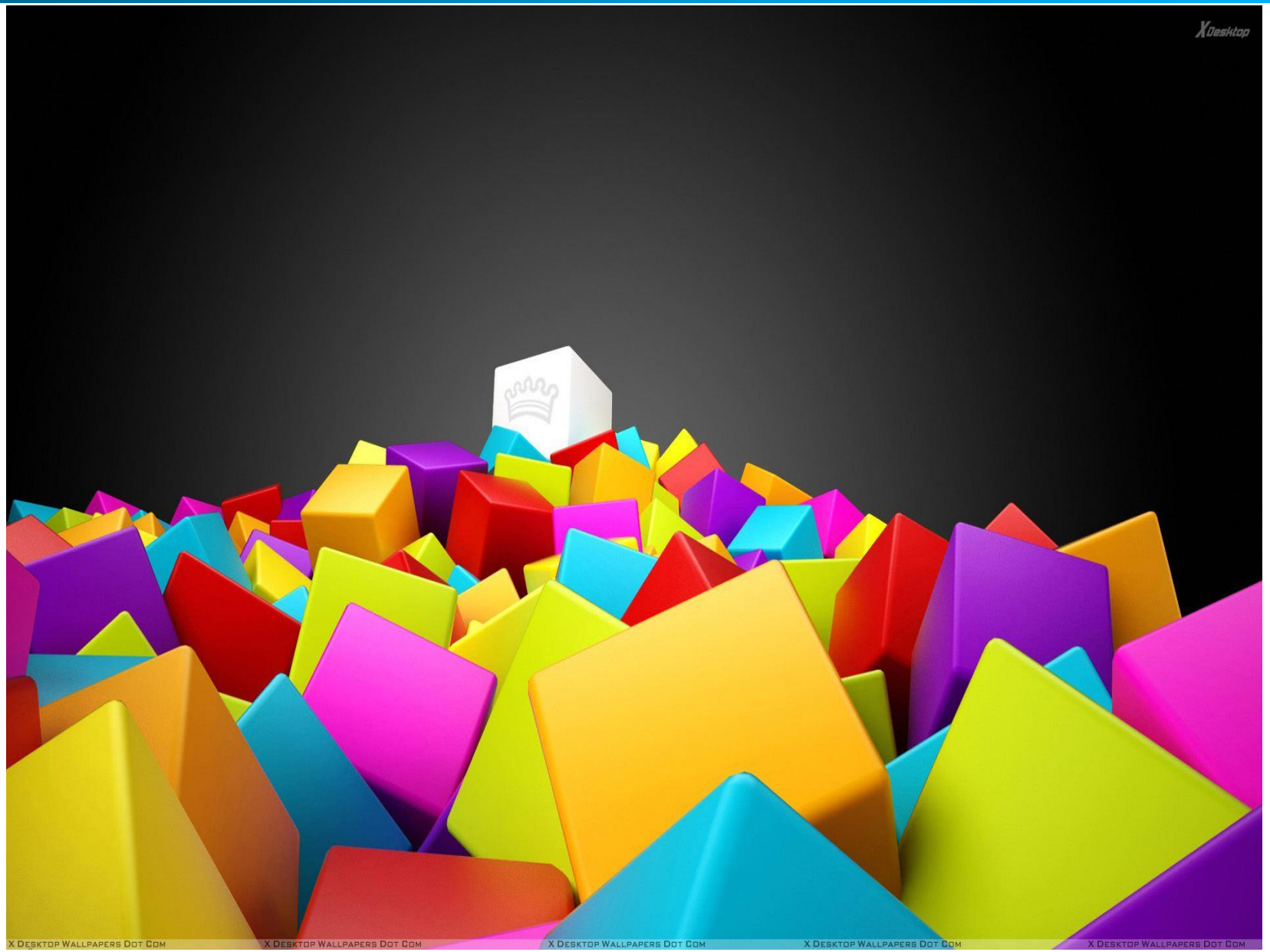
Martha Brook, P.E.

Standards Development Office
Energy Efficiency Division

Presentation Outline

- Background
- Compliance Modeling Workflow
- Under the Hood
- Issues & Opportunities

Background



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Background

Requirements for Public Domain Software

- Software is available to the public for its intended use at no or low cost
- Access to source code for development of derivative works
- Access to all data, logic and code to understand, review and critique the implementation of the performance compliance approach

Background

Constraint of Public Domain Software

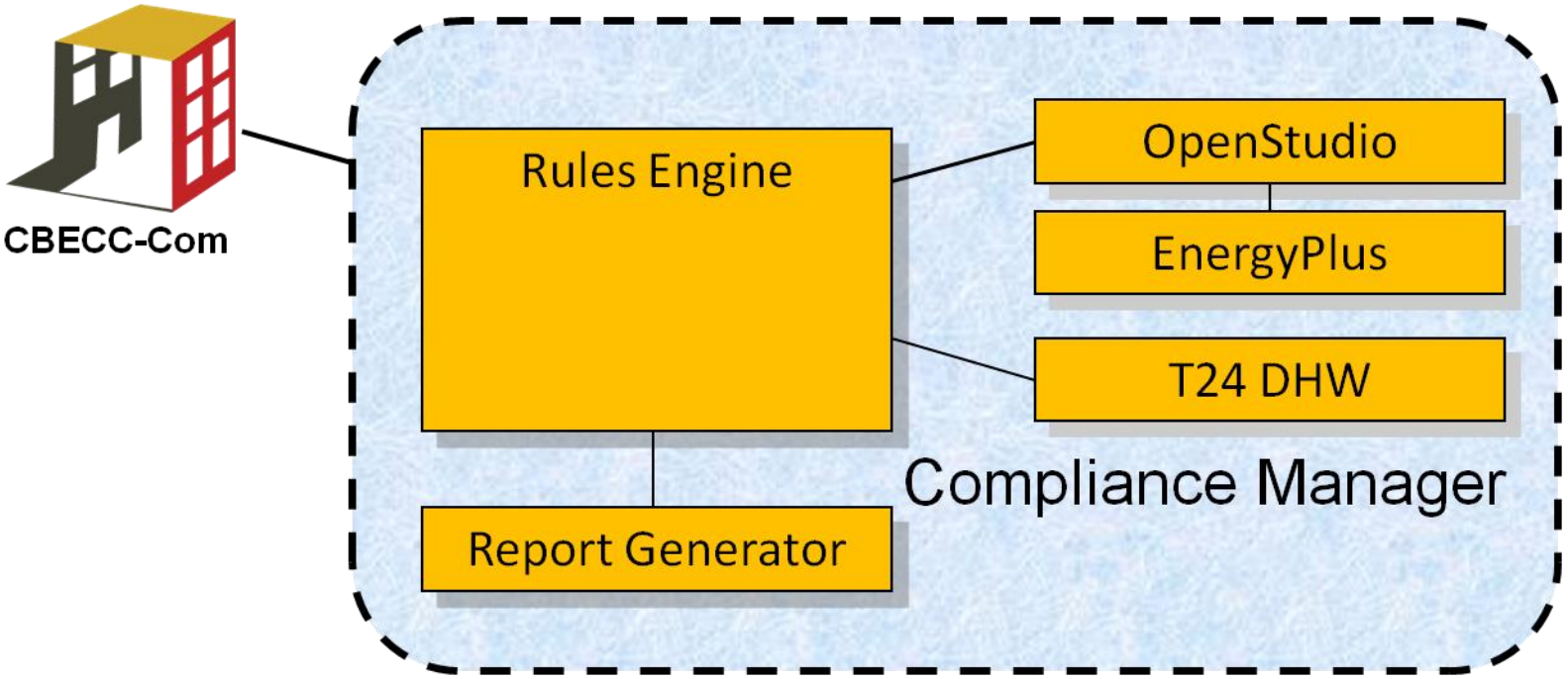
Software functionality will always be limited to what can be accomplished with available public resources and other donations

Background

CEC Issues (pre CBECC-Com)

- Limited licenses to distribute proprietary software
- No ability to fix bugs or update software
- Non-competitive contracting
- Few vendor options
- Multiple interpretations of the rules
- Dormancy in building energy simulation software advances
- Zero Net Energy

Background



Compliance Manager software tool library

Nonresidential Compliance Software

Background

EnergyPlus – energy analysis engine focused on commercial buildings

- Supported by U.S. DOE over last 15 years
- Prioritization of work to facilitate CEC adoption for 2013 Standards
- Includes low energy system modeling:
  - Natural ventilation
  - Displacement ventilation
  - Under floor air distribution systems
  - Evaporative cooling
- Distributed under an open source license

Background

OpenStudio – building energy analysis software platform using EnergyPlus

- Supported by U.S. DOE via National Renewable Energy Laboratory
- Building energy model translations
- EnergyPlus simulations
- Retrieves results
- Distributed under an open source license

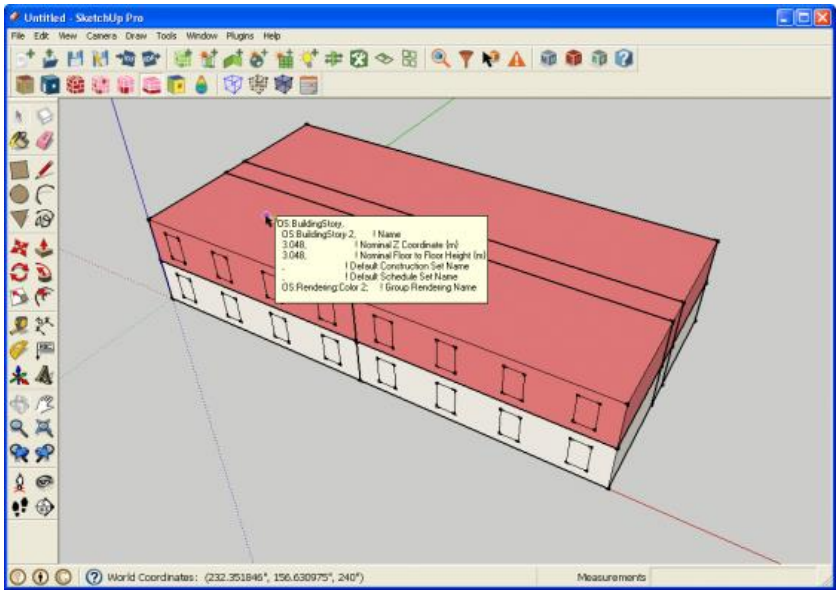
Background

Makes use of Building Information Modeling (BIM) industry standards for electronic data exchange of building geometry

green building XML - “gbXML”

Workflow to describe building:

1. Define Geometry in gbXML compliant tool (e.g. SketchUp)



2. Import building geometry

CBECC-Com

3. Define remaining properties in CBECC-Com (e.g. Lighting, HVAC, DHW)

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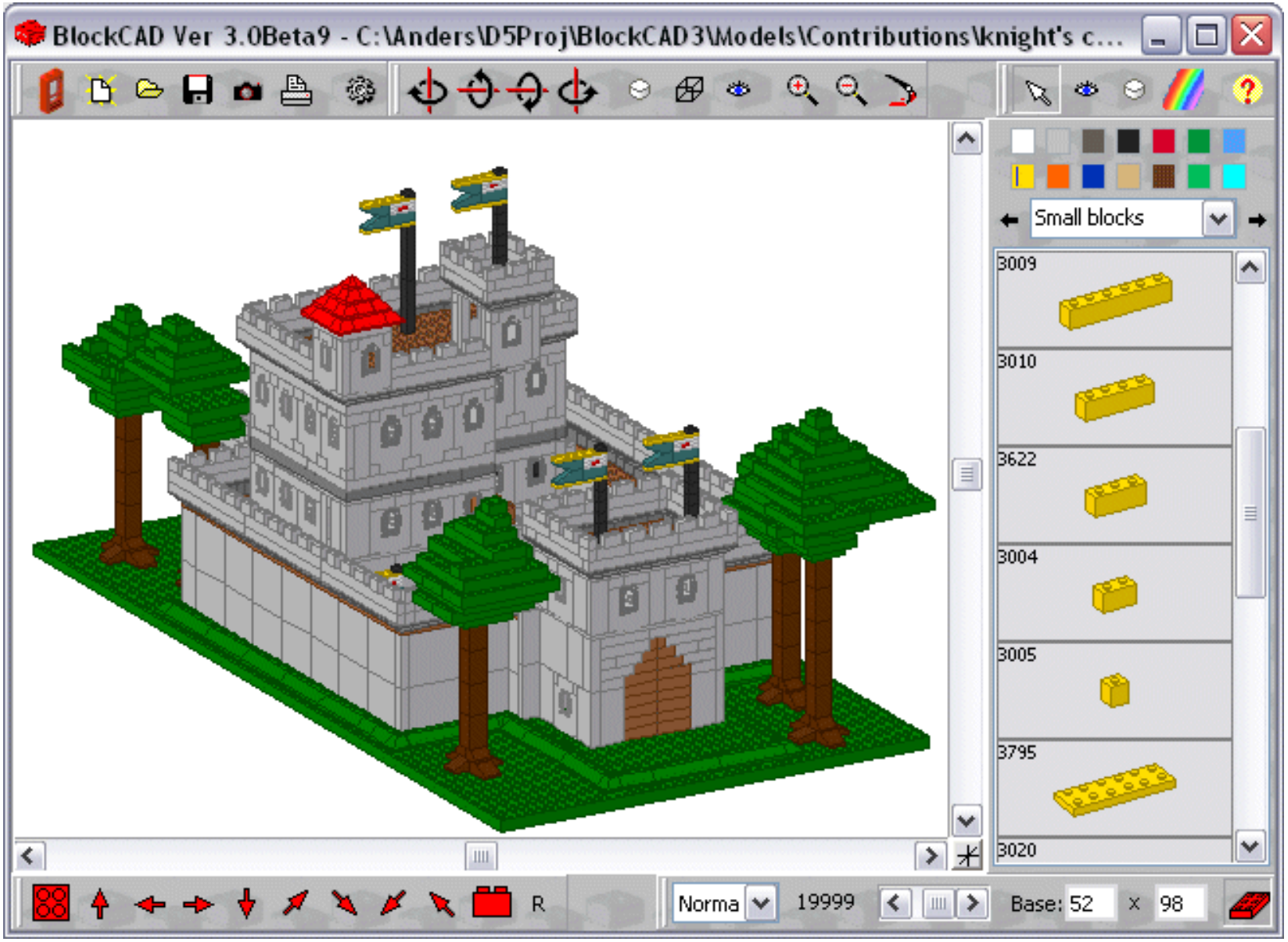
Modeling Workflow



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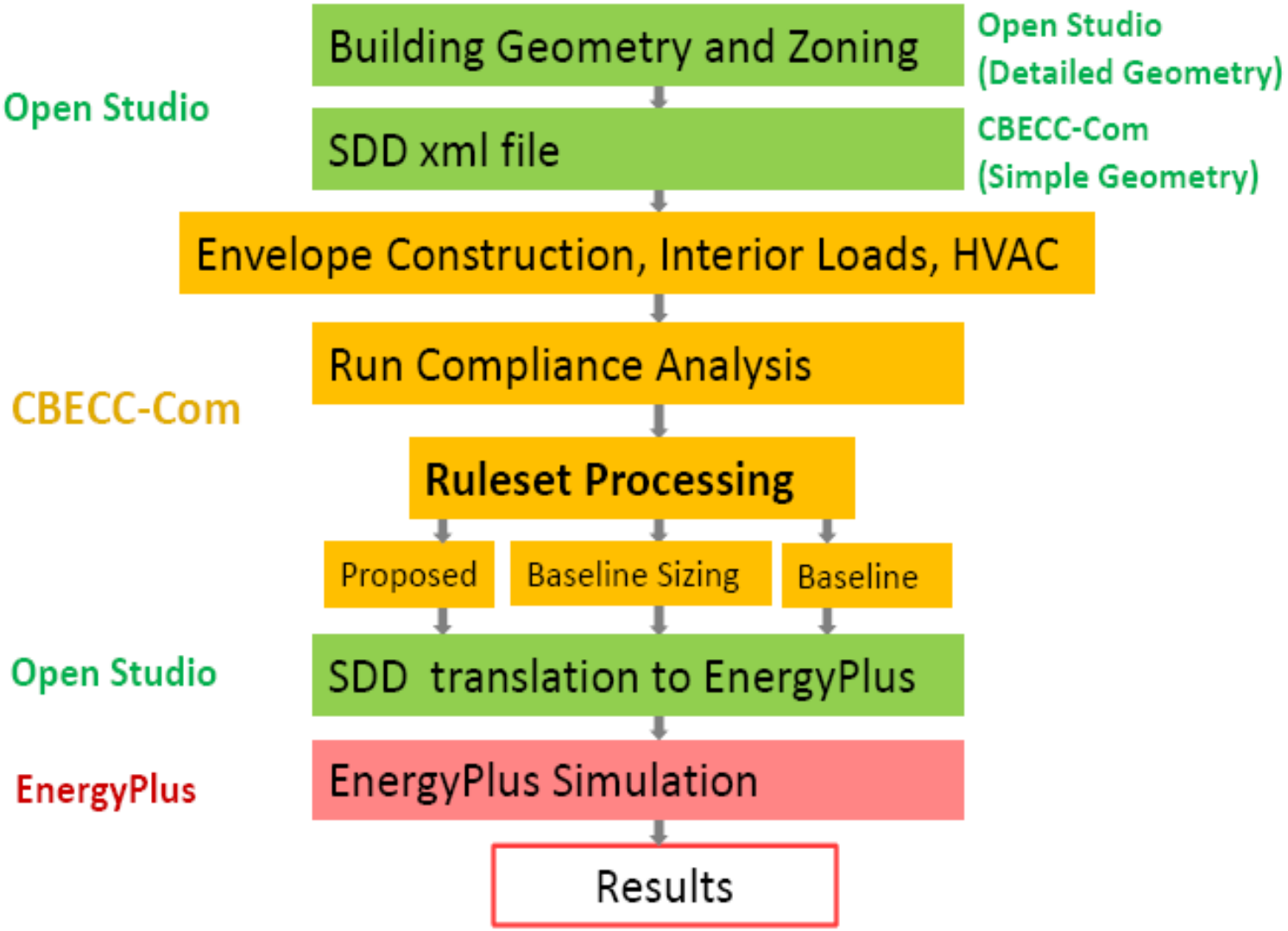
Modeling Workflow



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Title 24 2013 Compliance Software:

CBECC-Com

"California Building Energy Code Compliance for Commercial Buildings"

Creating Model Geometry

using the Detailed Geometry Approach

Title 24 2013 Compliance Software:

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"California Building Energy Code Compliance for Commercial Buildings"

Creating Building Geometry

using the Simplified Geometry Approach

Required Software: CBECC-Com v3

Modeling Workflow – Constructions

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CBECC-Com

"California Building Energy Code Compliance for Commercial Buildings"

Defining and Assigning Constructions

Modeling Workflow – Lighting & Loads

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"California Building Energy Code Compliance for Commercial Buildings"

Defining Lighting and Internal Loads

Modeling Workflow – HVAC

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"California Building Energy Code Compliance for Commercial Buildings"

Defining Packaged HVAC Systems

Modeling Workflow – Central Plants

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"California Building Energy Code Compliance for Commercial Buildings"

Defining Central Plant Systems

Modeling Workflow – DHW

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Defining Domestic Hot Water Systems

Modeling Workflow – Analysis

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Perform Analysis – Review Results

Under the Hood

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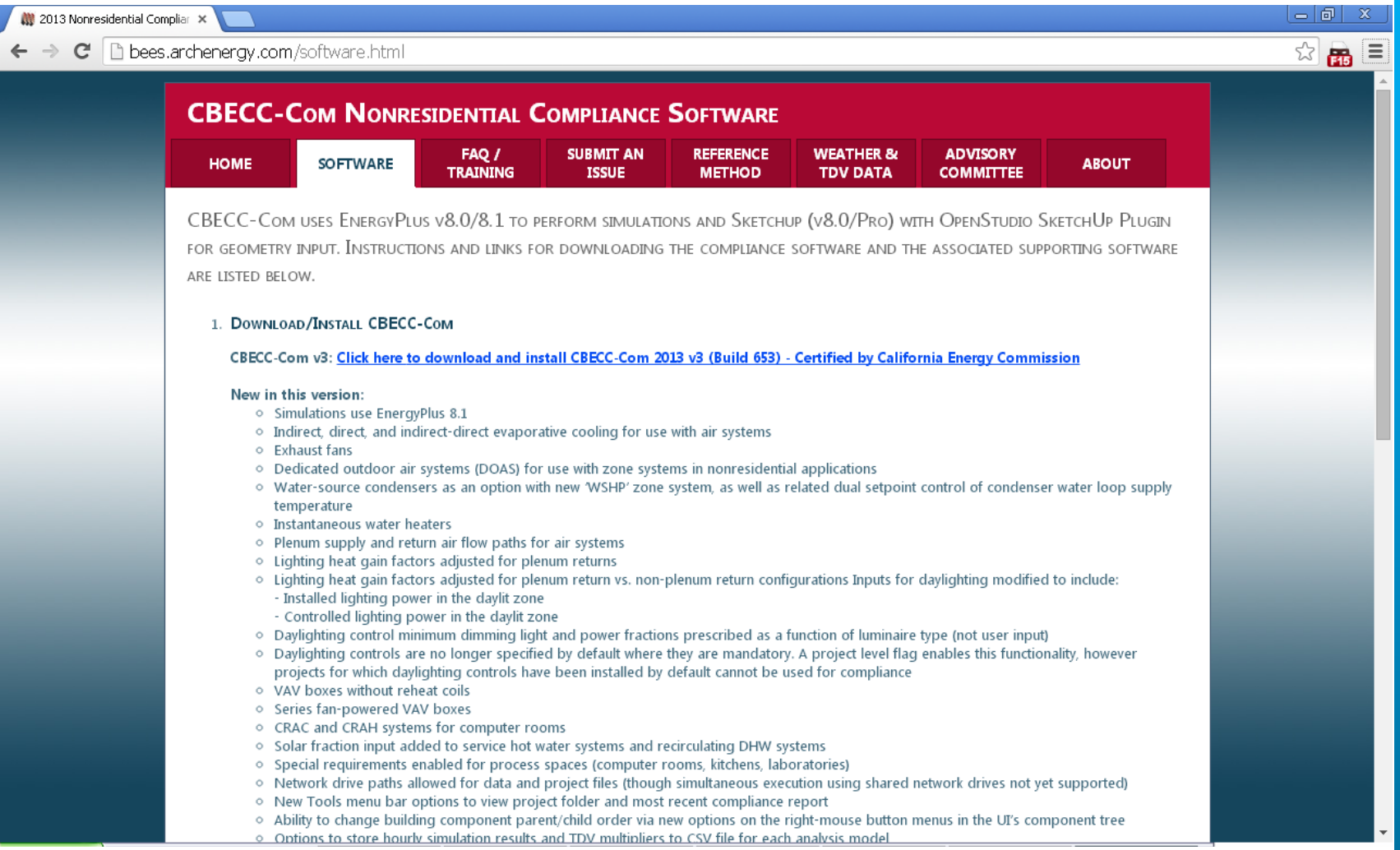
Under the Hood: web site



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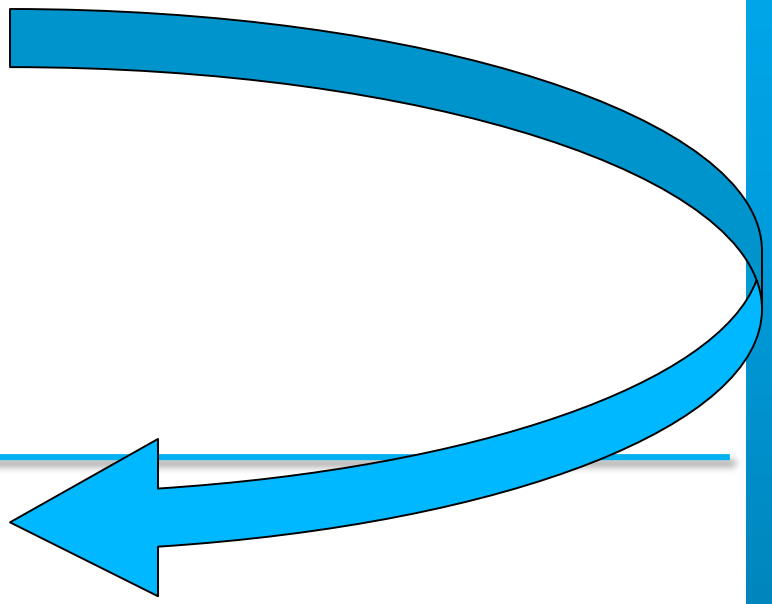
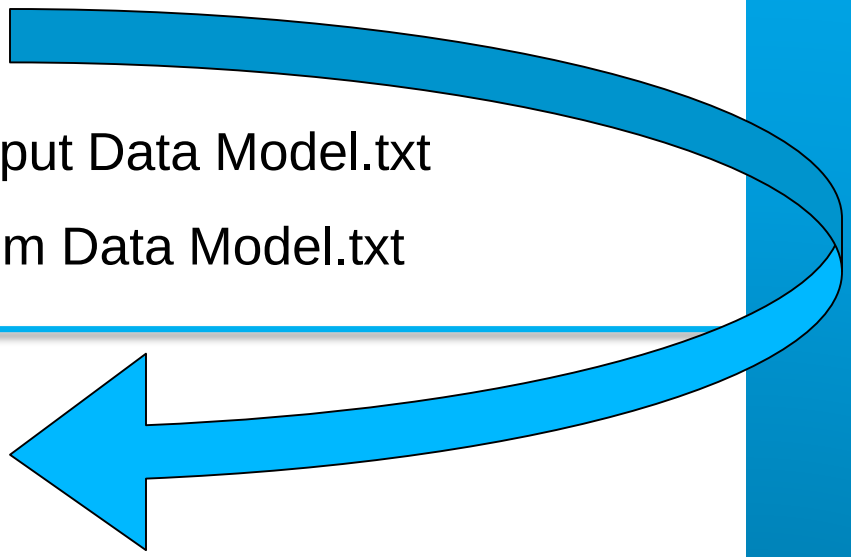
Under the Hood: reference documents

- CBECC-Com 2013 Data
  - ComplianceForms
  - Documents
  - EPW
  - Rulesets
- CBECC-Com 2013 Projects
  - Documents
    - ACM
    - RulesetSource



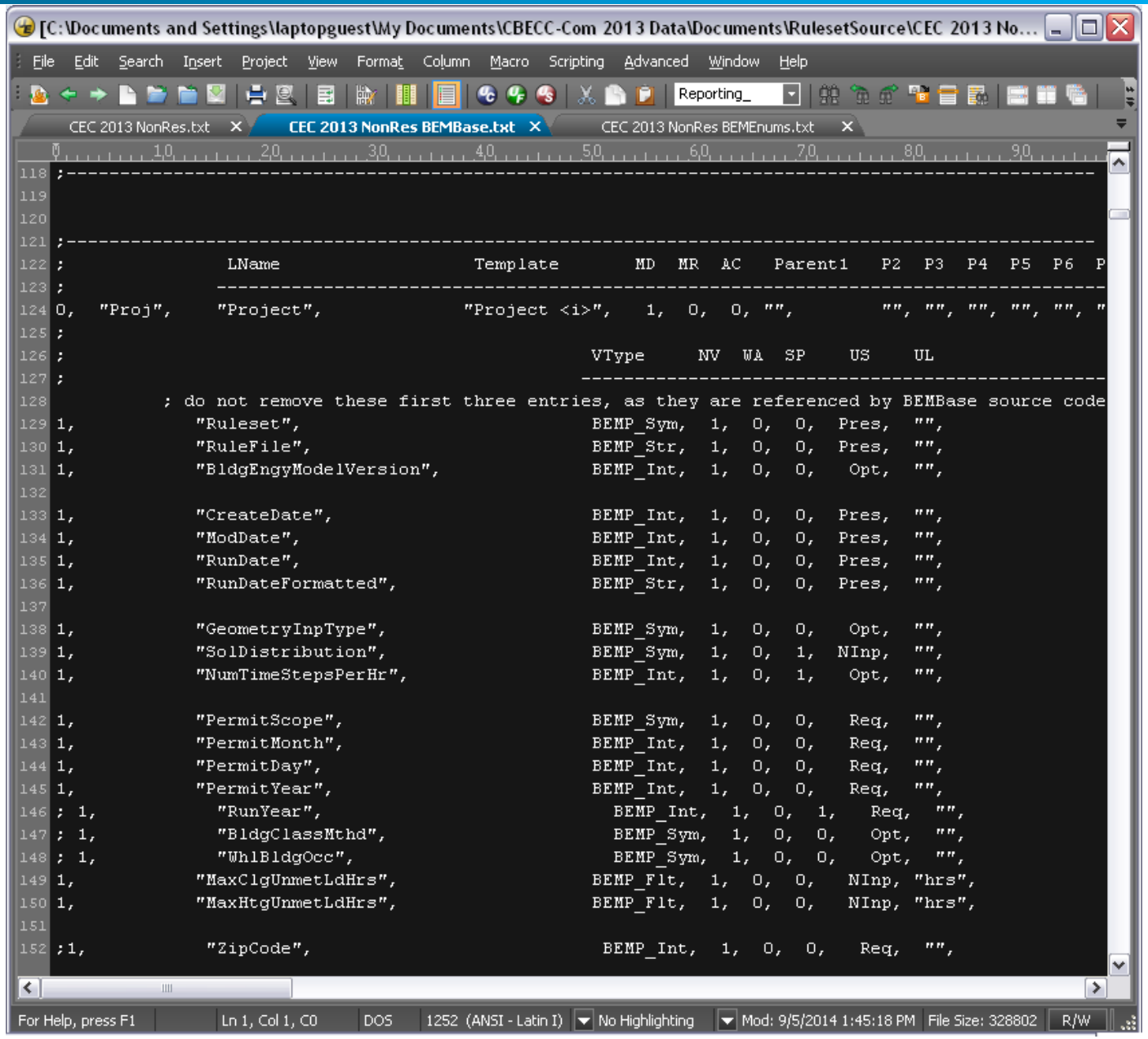
Under the Hood: data model files

- CBECC-Com 2013 Data
  - Documents
    - RulesetSource
      - CA 2013 Nonres
        - CEC 2013 NonRes - Input Data Model.txt
        - CEC 2013 NonRes - Sim Data Model.txt



- CA 2013 Nonres
  - Rules
    - CEC 2013 NonRes BEMEnums.txt
    - CEC 2013 NonRes BEMBase.txt
    - CEC 2013 NonRes Screens.txt

Under the Hood: data model



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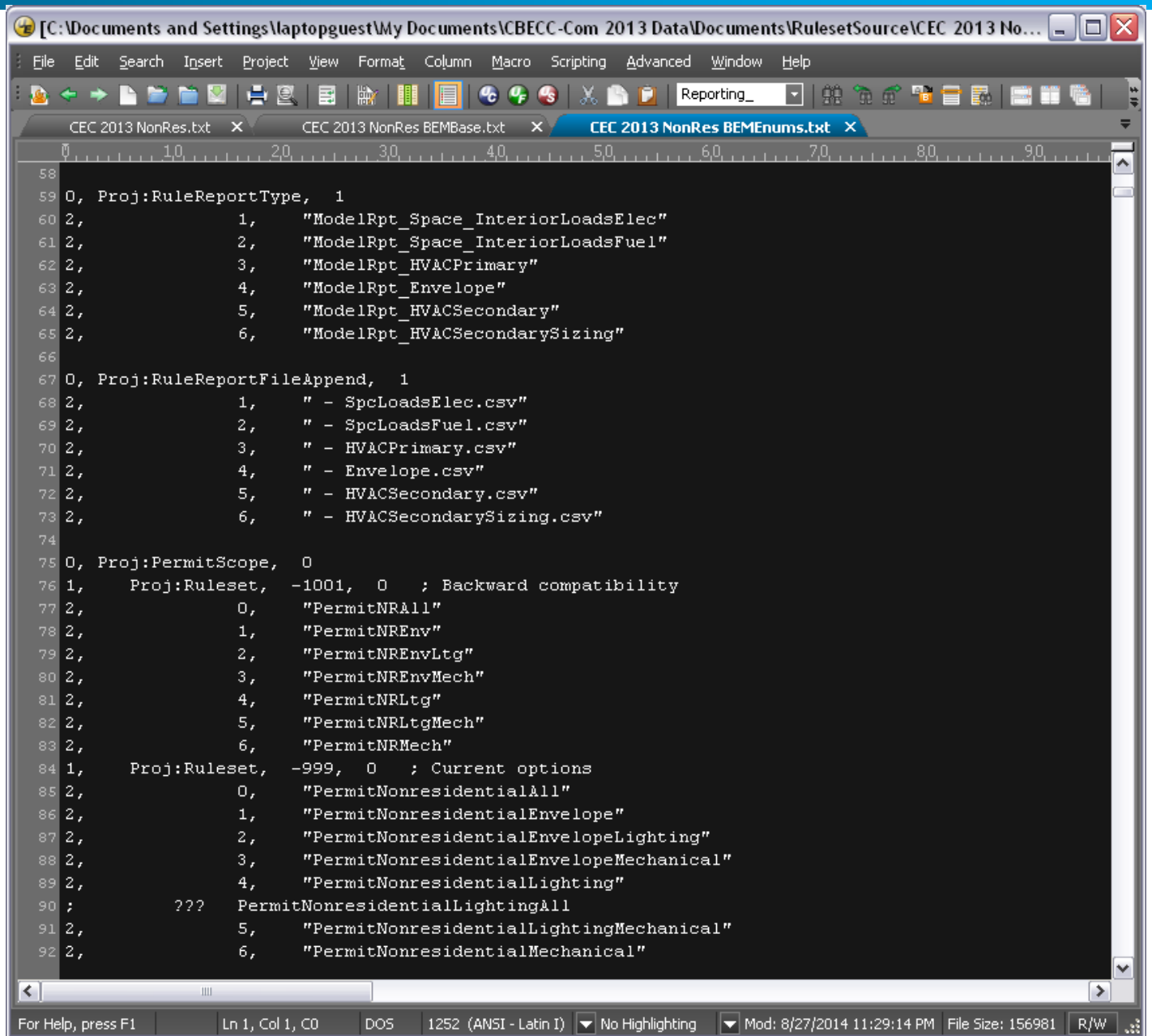
Under the Hood: enumerations



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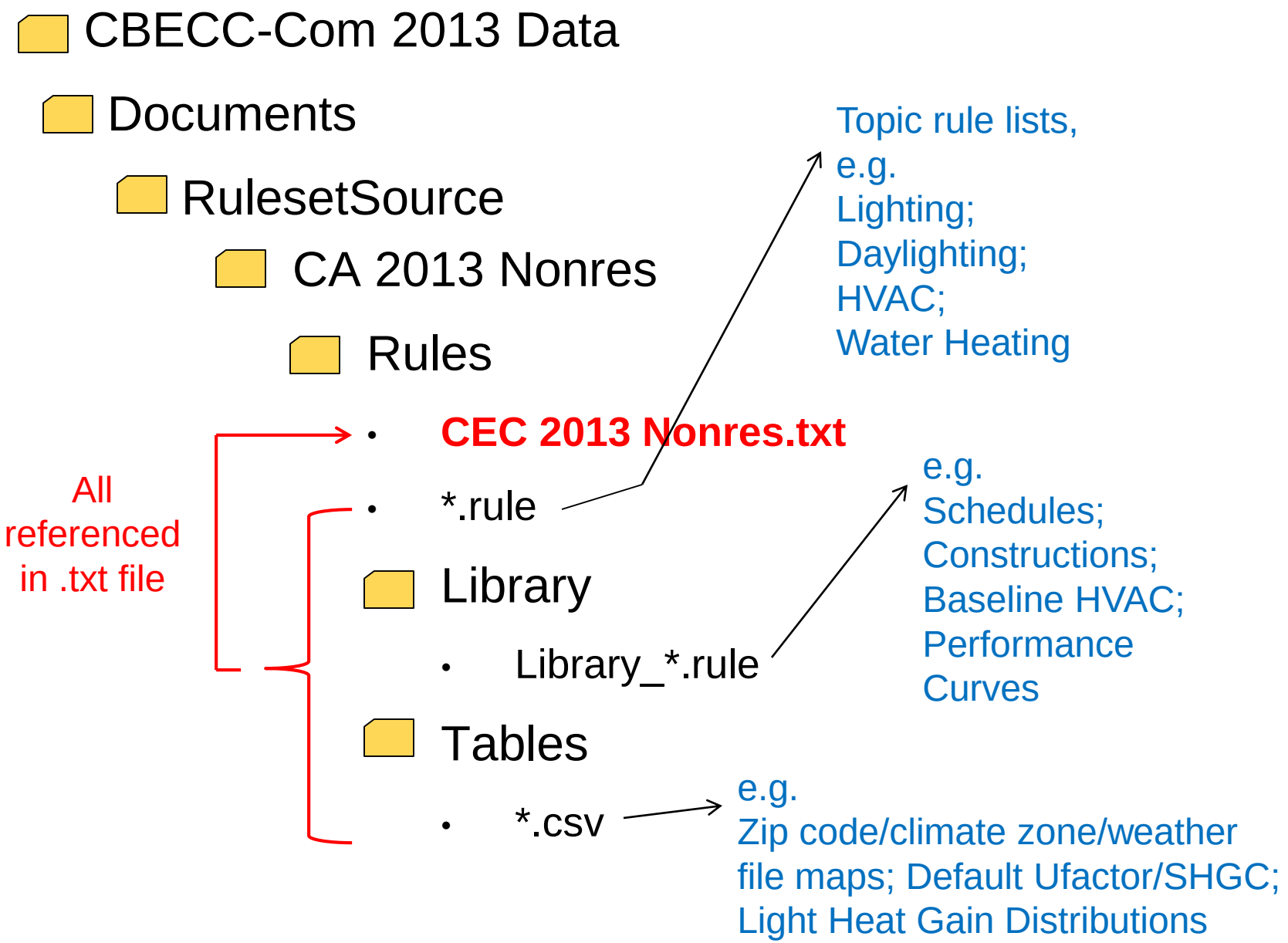
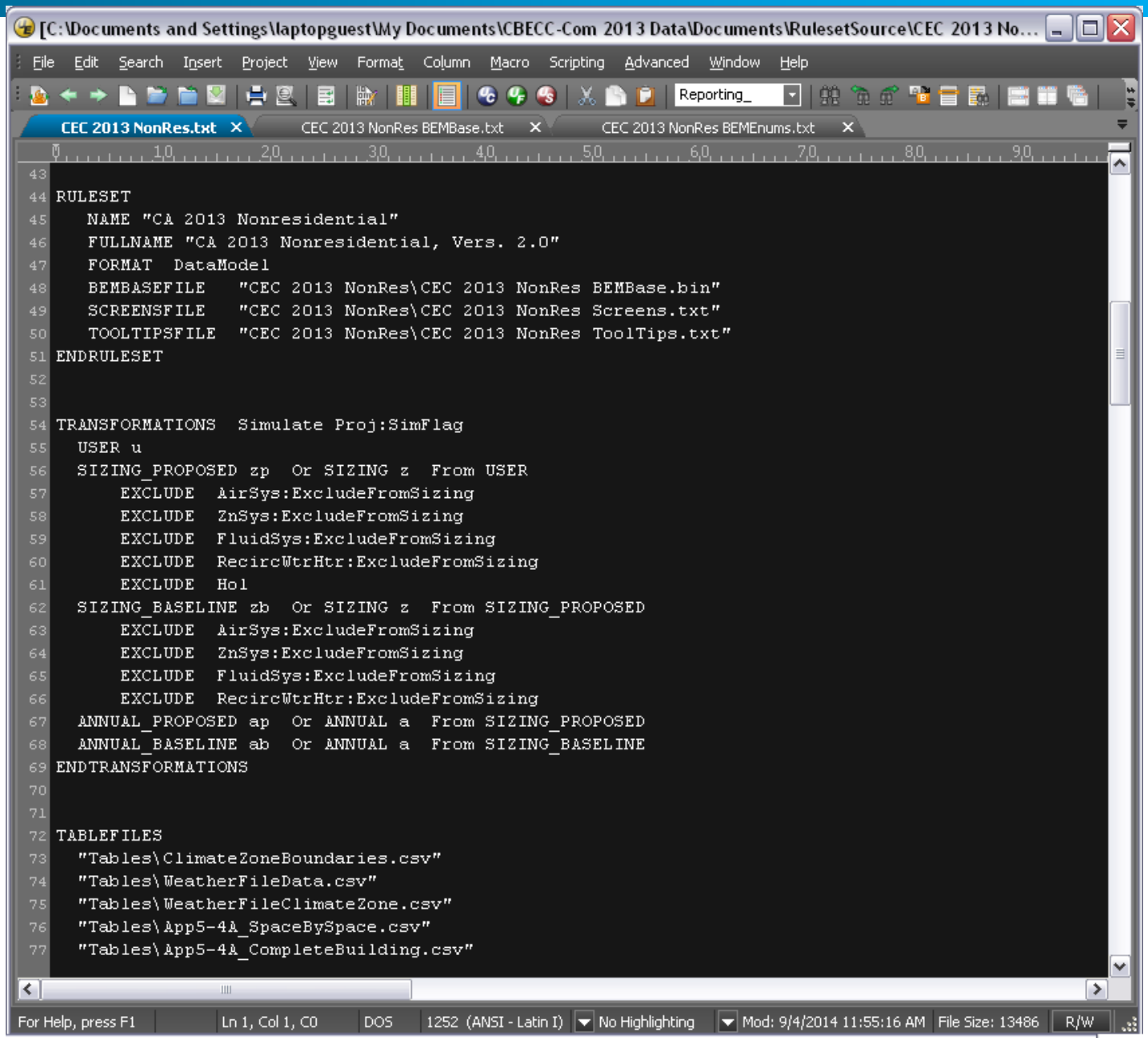
Under the Hood: ruleset source files



Under the Hood: main ruleset file



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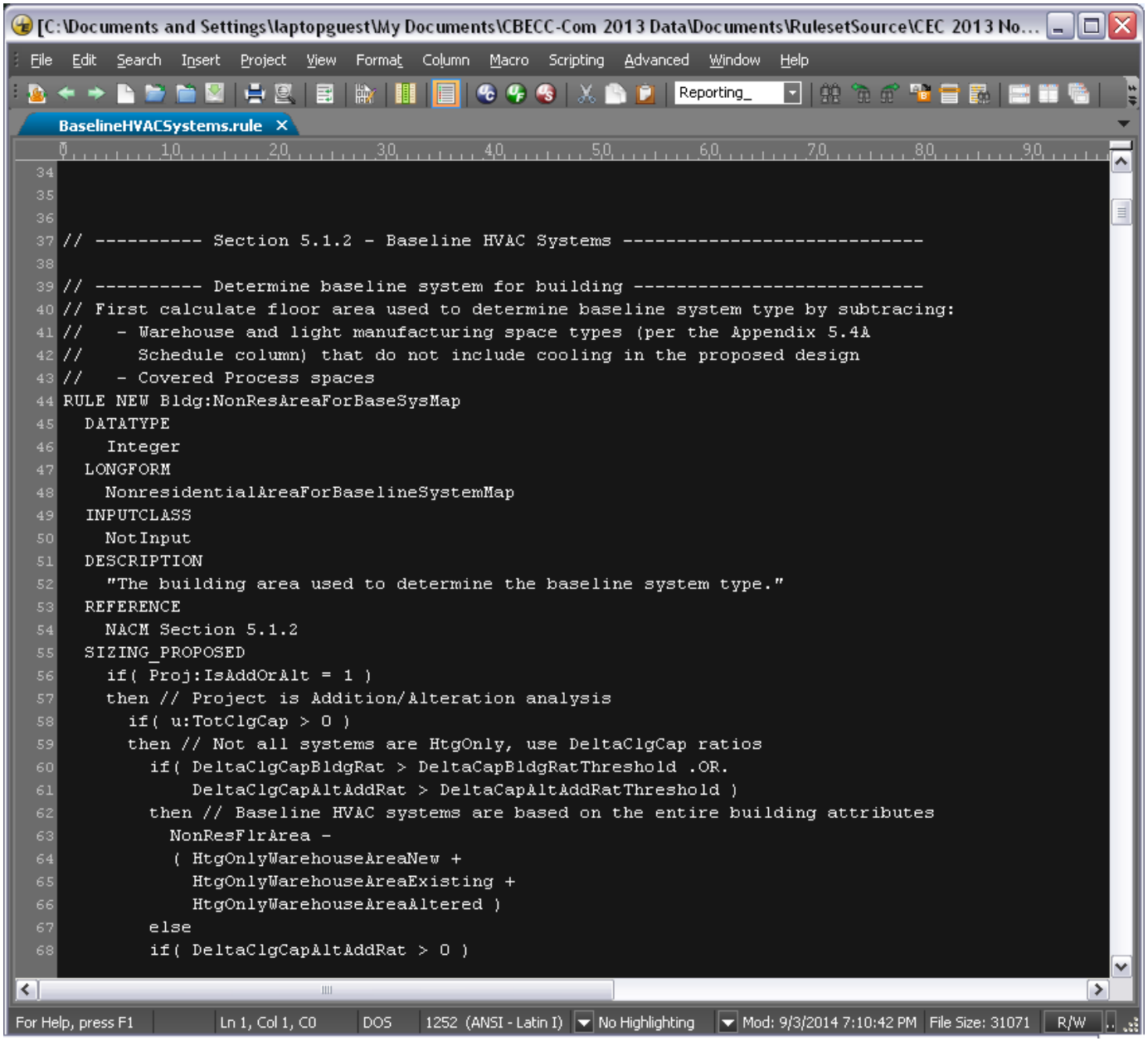
Under the Hood: baseline HVAC rules file



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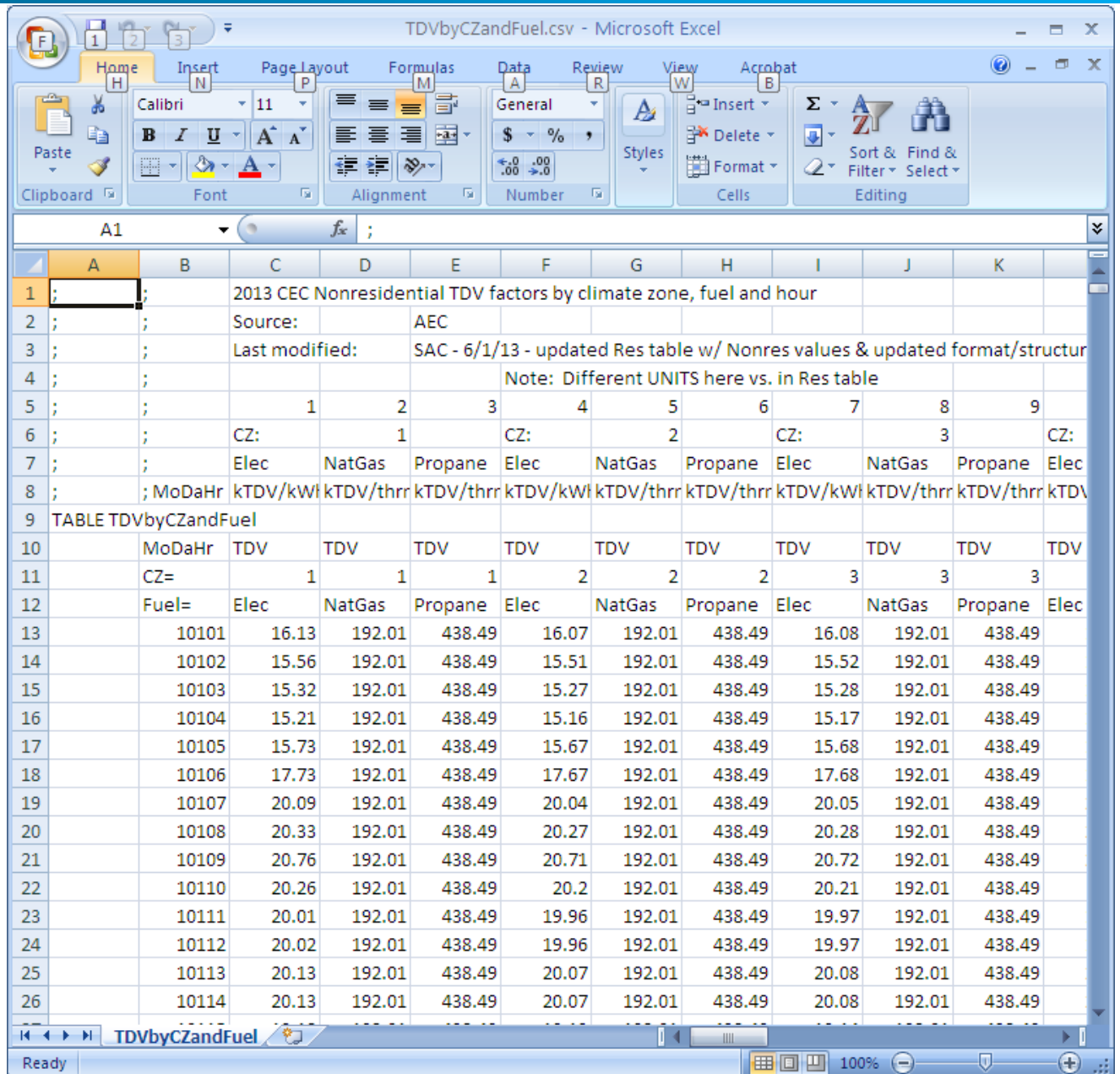
Under the Hood: TDV table



	A	B	C	D	E	F	G	H	I	J	K	
1	;	;	2013 CEC Nonresidential TDV factors by climate zone, fuel and hour									
2	;	;	Source:		AEC							
3	;	;	Last modified:		SAC - 6/1/13 - updated Res table w/ Nonres values & updated format/structur							
4	;	;				Note: Different UNITS here vs. in Res table						
5	;	;	1	2	3	4	5	6	7	8	9	
6	;	;	CZ:	1		CZ:	2		CZ:	3		CZ:
7	;	;	Elec	NatGas	Propane	Elec	NatGas	Propane	Elec	NatGas	Propane	Elec
8	;	; MoDaHr	kTDV/kWh	kTDV/thrm	kTDV/thrm	kTDV/kWh	kTDV/thrm	kTDV/thrm	kTDV/kWh	kTDV/thrm	kTDV/thrm	kTDV
9	TABLE TDVbyCZandFuel											
10		MoDaHr	TDV	TDV	TDV	TDV	TDV	TDV	TDV	TDV	TDV	TDV
11		CZ=	1	1	1	2	2	2	3	3	3	
12		Fuel=	Elec	NatGas	Propane	Elec	NatGas	Propane	Elec	NatGas	Propane	Elec
13		10101	16.13	192.01	438.49	16.07	192.01	438.49	16.08	192.01	438.49	
14		10102	15.56	192.01	438.49	15.51	192.01	438.49	15.52	192.01	438.49	
15		10103	15.32	192.01	438.49	15.27	192.01	438.49	15.28	192.01	438.49	
16		10104	15.21	192.01	438.49	15.16	192.01	438.49	15.17	192.01	438.49	
17		10105	15.73	192.01	438.49	15.67	192.01	438.49	15.68	192.01	438.49	
18		10106	17.73	192.01	438.49	17.67	192.01	438.49	17.68	192.01	438.49	
19		10107	20.09	192.01	438.49	20.04	192.01	438.49	20.05	192.01	438.49	
20		10108	20.33	192.01	438.49	20.27	192.01	438.49	20.28	192.01	438.49	
21		10109	20.76	192.01	438.49	20.71	192.01	438.49	20.72	192.01	438.49	
22		10110	20.26	192.01	438.49	20.2	192.01	438.49	20.21	192.01	438.49	
23		10111	20.01	192.01	438.49	19.96	192.01	438.49	19.97	192.01	438.49	
24		10112	20.02	192.01	438.49	19.96	192.01	438.49	19.97	192.01	438.49	
25		10113	20.13	192.01	438.49	20.07	192.01	438.49	20.08	192.01	438.49	
26		10114	20.13	192.01	438.49	20.07	192.01	438.49	20.08	192.01	438.49	

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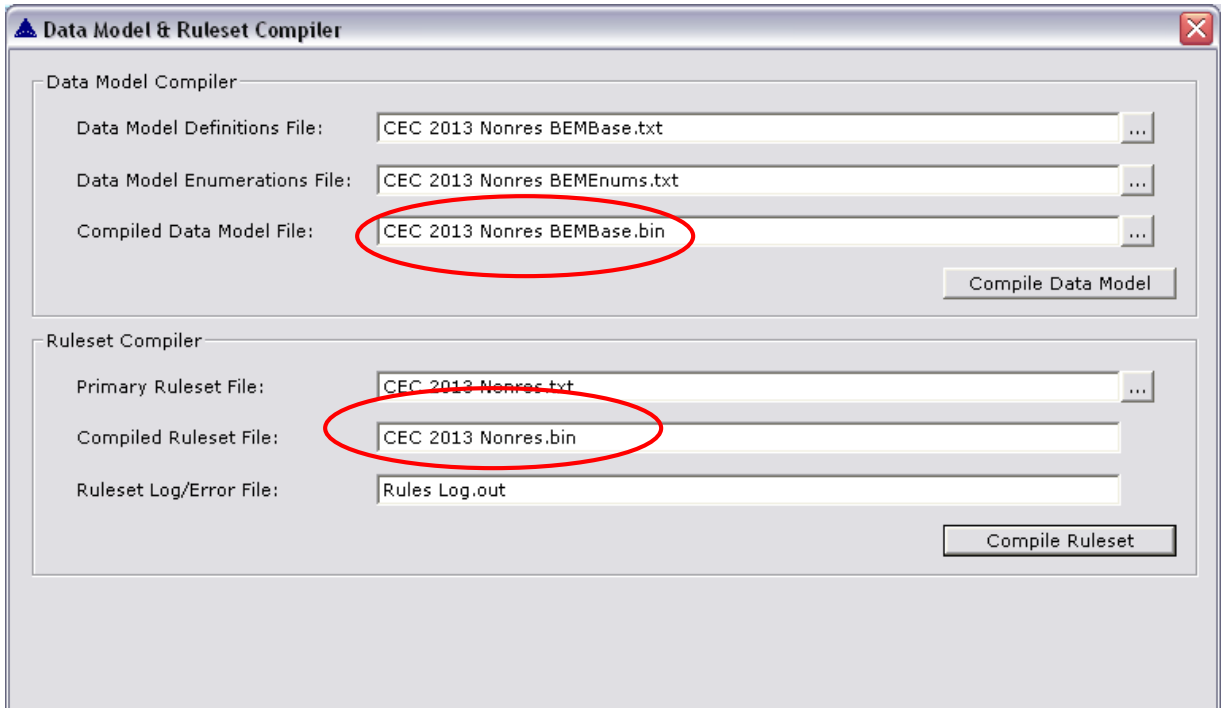
Under the Hood: data model & ruleset compiler

- Program Files
  - CBECC-Com 2013
    - EPlus
    - T24DHW
      - BEMPCmpl.exe



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Under the Hood: reference documents

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  - ComplianceForms
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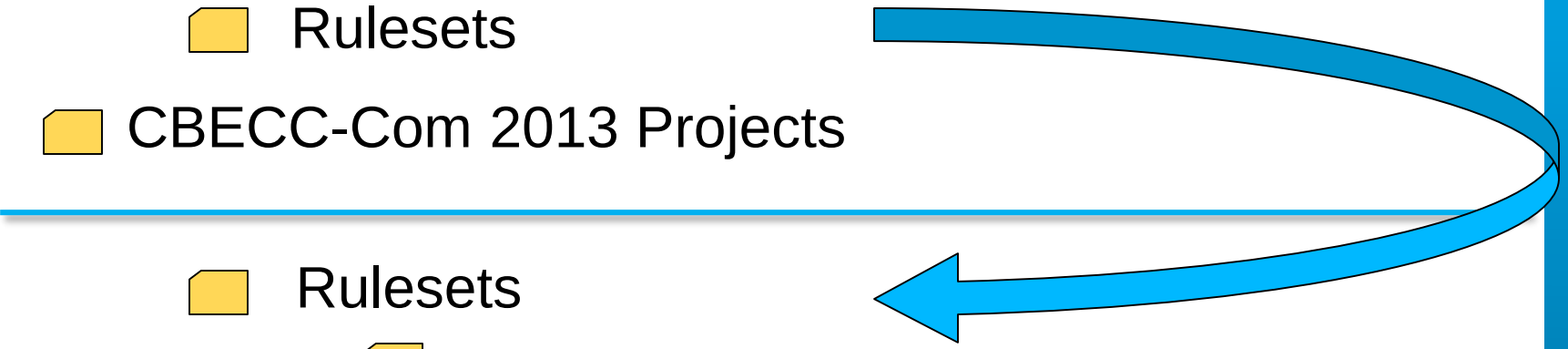
  - EPW
  - Rulesets
- CBECC-Com 2013 Projects
  - Rulesets
    - CEC 2013 Nonres

CEC 2013 NonRes Screens.txt

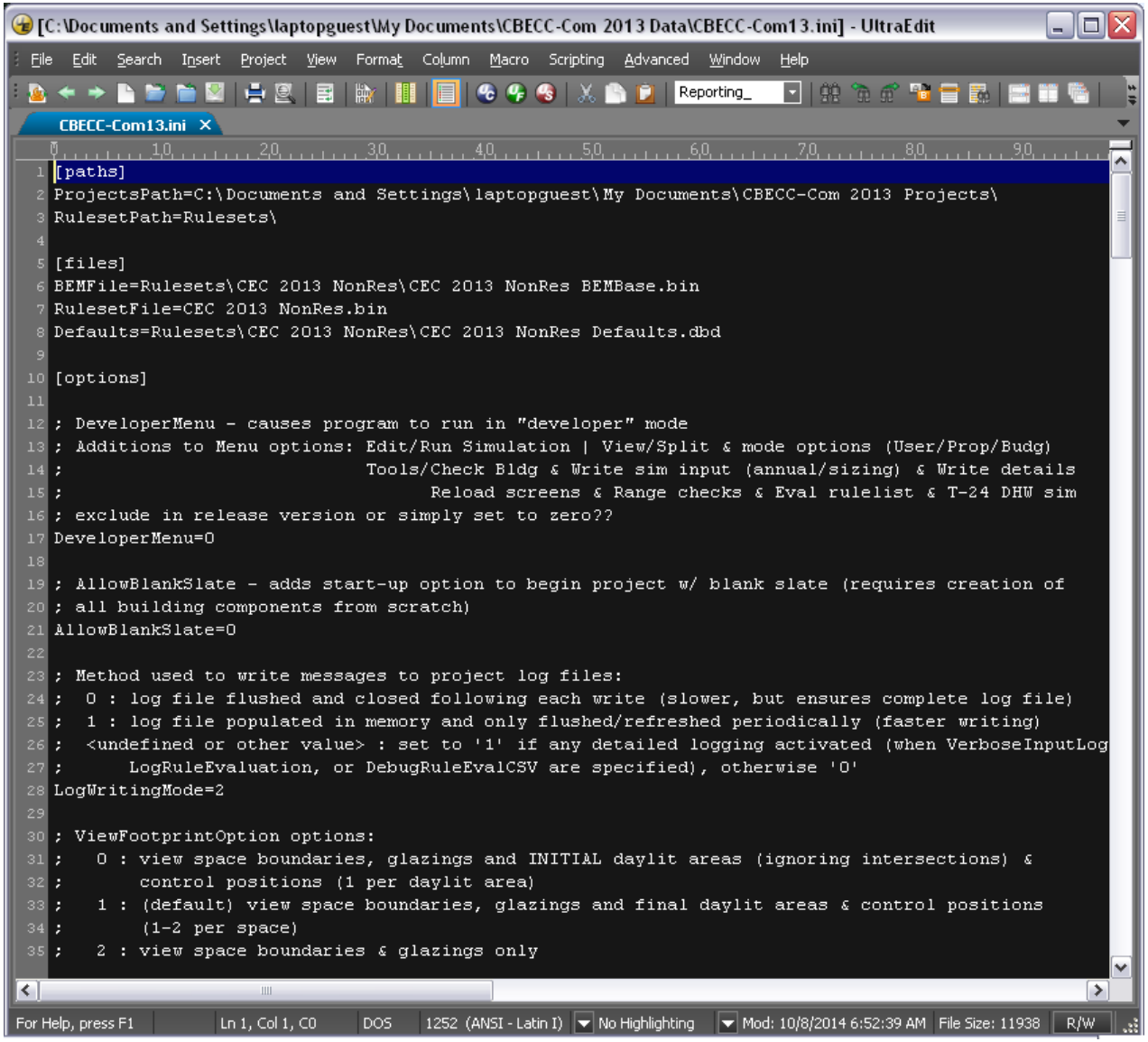
Compiled data model → CEC 2013 NonRes BEMBase.bin

CEC 2013 NonRes.bin ← Compiled ruleset



Under the Hood: CBECC-Com13.ini

- CBECC-Com 2013 Data



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Under the Hood: projects folder

- CBECC-Com 2013 Projects
  - Samples
  - Standard Tests
  - Other Tests

    *.cibd

    *.log

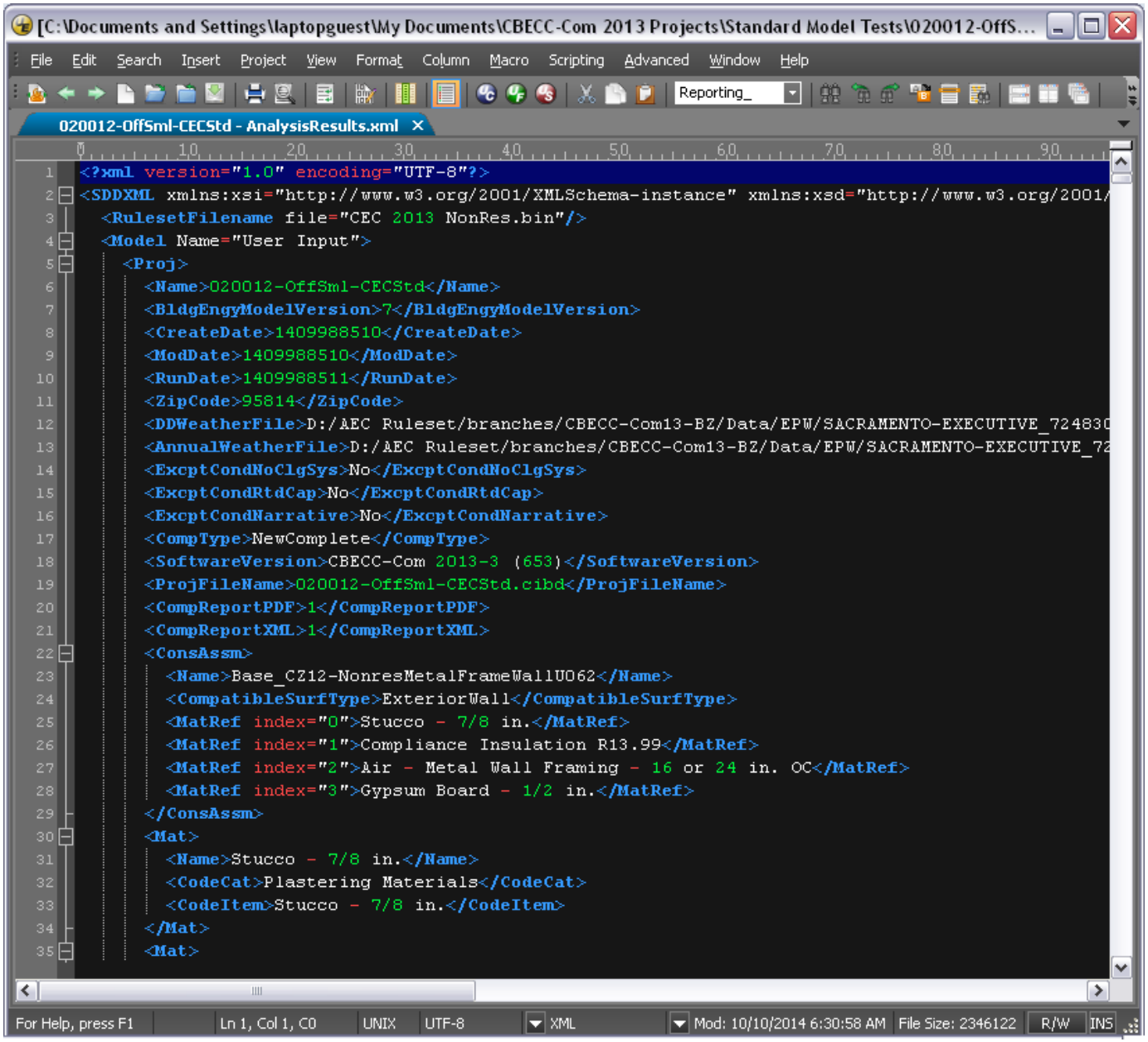
    *- AnalysisResults.xml

    - AnalysisResults-BEES.xml
  - 020012-OffSml-CECStd – run

    zp, ap, zb, ab - *.csv envelope, space loads, HVAC

    zp, ap, zb, ab - *.xml complete building model

Under the Hood: AnalysisResults.xml



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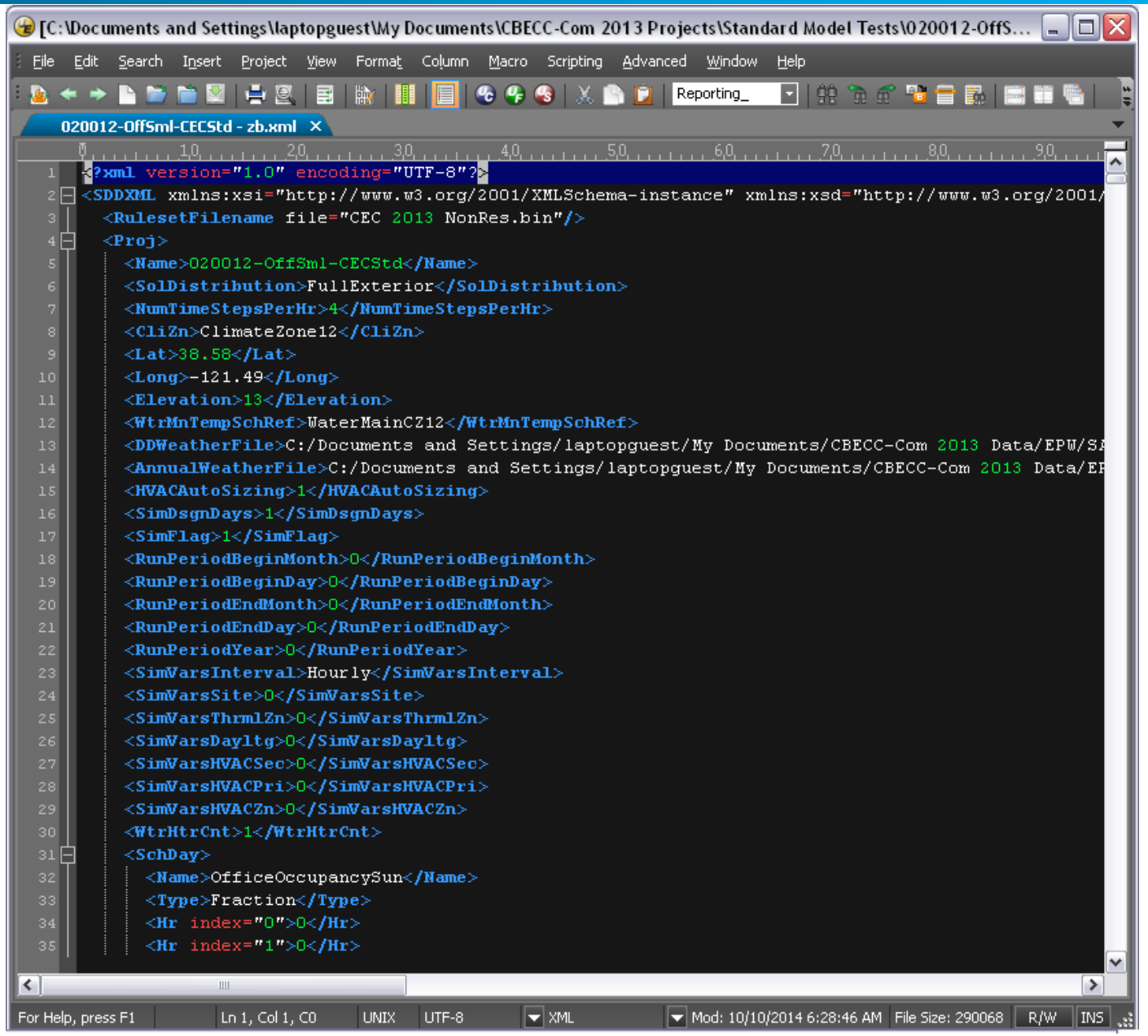
Under the Hood: *.csv



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Issues & Opportunities

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Standards

Issues & Opportunities

Compliance Analysis Run Time

- Adding option to use reduced calendar (# of weeks) for design parametrics
- Must still complete annual simulation for compliance certificate w/o watermark (once)
- No CEC guarantee that reduced run periods will match annual compliance results
- Available in November 2014 release

Issues & Opportunities

Compliance Forms

- Working to reduce the bulk of prescriptive forms needed to supplement PERF-1
- Utility ACE team working with building departments, energy consultants, CEC to re-design PERF-1
- January 2015 – PERF-1 produced by CBECC-Com will stand alone – no additional prescriptive forms will be needed

Issues & Opportunities

HVAC Sizing

- 2013 Nonres ACM Manual specifies that HVAC sizes must be specified for the Proposed Design
- Energy consultants must work with mechanical designers to obtain these equipment specifications
- PERF-1 will not be generated if proposed HVAC equipment does not meet the calculated loads
- CBECC-Com includes the ability to specify in the PERF-1 if it is necessary to model equipment that will not be installed

Issues & Opportunities

Shading

- 2D Geometry version of CBECC-Com currently does not include modeling of shading
- Some options to gain credit for shading will be added in early 2015

mbrook@energy.ca.gov