

**Documentation of the BEMCmpMgr (CEC Compliance Manager) DLL
For Analysis of Commercial Buildings
SAC 9/30/2019 (v16) (latest changes in Red font)**

The purpose of this document is to provide information needed to develop software interfaces to the CEC Compliance engine DLL(s). The primary library third party tools will interface with is **BEMCmpMgr19c.dll** for **2019** analysis. This DLL manages the compliance analysis processing, including:

- Evaluation of compliance rules on user input building models (via **BEMProc19c.dll**),
- Simulation of the proposed and standard building models (via OpenStudio/EnergyPlus), and
- Generation of compliance reports (informal reports internal to compliance manager, certified reports via web-based report generator).

The analysis engine DLLs are based solely on open source dependencies (primarily boost, Qt C++, OpenSSL and OpenStudio libraries), **whereas the CBECC-Com UI still requires** Microsoft (Windows) libraries. **All 2019 DLLs and executables are compiled as 64-bit programs.**

There are only a handful of exports needed to perform compliance analysis and retrieve analysis results/reports. One initializes the DLLs, one performs the analysis (and potentially generates a report), another to generate a draft report from an existing analysis results file, three more are designed to retrieve data (inputs and/or results) from the building model following analysis, a couple more to retrieve error messages and the last is used to clean-up following exit.

The overall analysis data model is broken into a few subsets, one of which is the “Input Data Model”. This is the version of most interest to third party tools wishing to generate files that can be analyzed for compliance using this tool. The Input Data Model is documented in a text file contained in each release of CBECC-Com, residing in the “Data” directory of the install, at:

<CBECC-Com xxx Data>\Documents\RulesetSource**T24N_2019** - Input Data Model.txt

There is one variation associated with the input data model that is important to understand, and that has to do with the ability to describe buildings using either “Detailed” or “Simplified” geometry. There are certain limitations on building and analysis features when using the simplified approach, while any/all features and analysis can be performed on detailed geometry projects. For more information on this topic, refer to the CBECC-Com User’s Manual.

A new feature of the Input Data Model text file is the ability to specify whether or not certain building object properties should or should not be included in detailed vs. simplified building model files submitted for analysis. This is denoted in the highlighted excerpt from the Input Data Model text:

```
Spc                Space                #Props:109/340  MaxDefinable: 1000
                  Parent(s): Story
                  Children: IntLtgSys / DaylgtCtrl / Ceiling / ExtFlr...
...
Area ... Float ... Units: ft2 ... (see next line) Error if not: Value >= 0.01
...                                     Compulsory when Proj:GeometryInpType = 'Simplified', else NotInput
```

One data model variation that is NOT documented in the Input Data Model text file (described above) is the inclusion of PolyLp (PolyLoop) objects in project files. Detailed geometry projects should include PolyLp children for Spc (Space) objects and all types of surfaces, shading devices (Ceiling, ExtFlr, ExtWall, IntFlr, IntWall, Roof, UndgrFlr, UndgrWall, Win, Skylt, Dr & ExtShdgObj) & **photovoltaic array objects (PVArray, PVArrayGeom &**

PVArrayShade). Simplified geometry projects should include NO PolyLp objects. If PolyLp objects are included in simplified geometry projects, they will be removed and not considered during analysis.

Recommended sequence of events (assuming use of Visual Studio & C++) for a scenario where direct linking to the compliance manager DLLs is not required:

1. Load the pertinent DLLs via LoadLibrary() -->> "libeay32.dll", "ssleay32.dll", "Qt5Core.dll", "Qt5Xml.dll", "Qt5Gui.dll", "Qt5Network.dll", "Qt5WebKit.dll", "Qt5Widgets.dll", "**BEMProc19c.dll**" and "**BEMCmpMgr19c.dll**"
This step MAY not be required if the third party application and these referenced DLLs are located in the same directory.
2. Call GetProcAddress() to retrieve function pointers to each DLL function you plan to call.
3. For each building model to be simulated:
 - Call CMX_PerformAnalysis_CECNonRes() to perform the compliance analysis AND generate compliance report(s). An Alternative here is to use CMX_PerformAnalysisCB_NonRes() if you wish to provide a callback function pointer enabling progress monitoring and mid-analysis abort within your application.
 - If the desired compliance report(s) are not generated via the Analysis call above, then call CMX_GenerateReport_CEC() (or CMX_GenerateReport_Proxy_CEC() to provide proxy server info) to generate a PDF compliance report based on the results contained in an XML file identified by the calling application.
 - Call CMX_GetDataString(), CMX_GetDataInteger(), &/or CMX_GetDataFloat() any number of times to retrieve building model inputs, calculated defaults or simulation results (anything stored in the building model).
 - Call CMX_GetRulesetErrorCount() to retrieve the number of errors encountered during the analysis and CMX_GetRulesetErrorMessage() to retrieve individual error message character strings.
 - Call CMX_ExportCSVHourlyResults_CECNonRes() to export a CSV file containing hourly simulation results and TDV multipliers for a single analysis run (proposed vs. standard).
4. Call CMX_ExitBEMProcAndCmpMgrDLLs() following all simulations to clean-up BEMProc16c & BEMCmpMgr16c data.
5. Unload the loaded DLLS (in reverse order) via FreeLibrary() -->> "**BEMCmpMgr19c.dll**" and "**BEMProc19c.dll**", then "Qt5Widgets.dll", "Qt5WebKit.dll", "Qt5Network.dll", "Qt5Gui.dll", "Qt5Xml.dll", "Qt5Core.dll", "ssleay32.dll", and "libeay32.dll"
This step not required if the third party DLLs are not explicitly loaded in step 1.

Function Reference

The following are names and documentation pertaining to the compliance manager routines referenced above

int	CMX_PerformAnalysis_CECNonRes (const char*	pszBEMBasePathFile,	
	const char*	pszRulesetPathFile,	const char*	pszSimWeatherPath,
	const char*	pszCompMgrDLLPath,	const char*	pszDHWeatherPath,
	const char*	pszProcessingPath,	const char*	pszModelPathFile,
	const char*	pszLogPathFile,	const char*	pszUIVersionString,

```

bool bLoadModelFile,                const char* pszAnalysisOptionsCSV,
char* pszErrorMessage,             int iErrorMsgLength,
bool bDisplayProgress,            HWND hWnd,
char* pszResultsSummary,          int iResultsSummaryLen,
int iSecurityKeyIndex,            const char* pszSecurityKey );

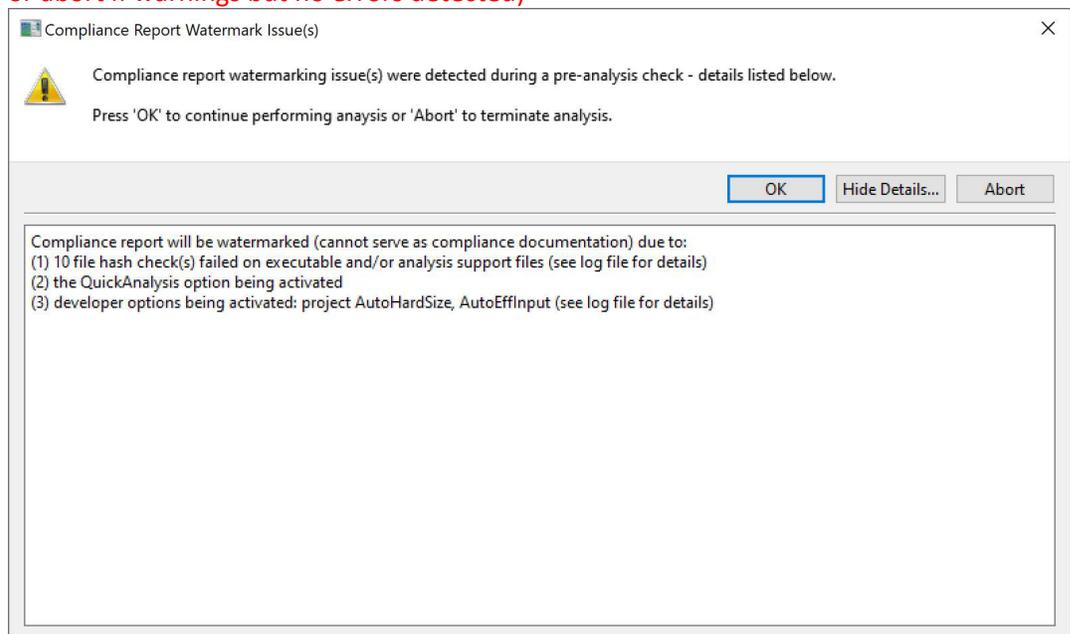
// typedef int  (__cdecl *PCMX_PerformAnalysis_CECNonRes)( const char*,
//                                                         const char*, const char*, const char*,
//                                                         const char*, const char*, const char*,
//                                                         const char*, const char*, bool,
//                                                         const char*, char*, int, bool, HWND, char*, int,
//                                                         int, const char* );
// _CMX_PerformAnalysis_CECNonRes

```

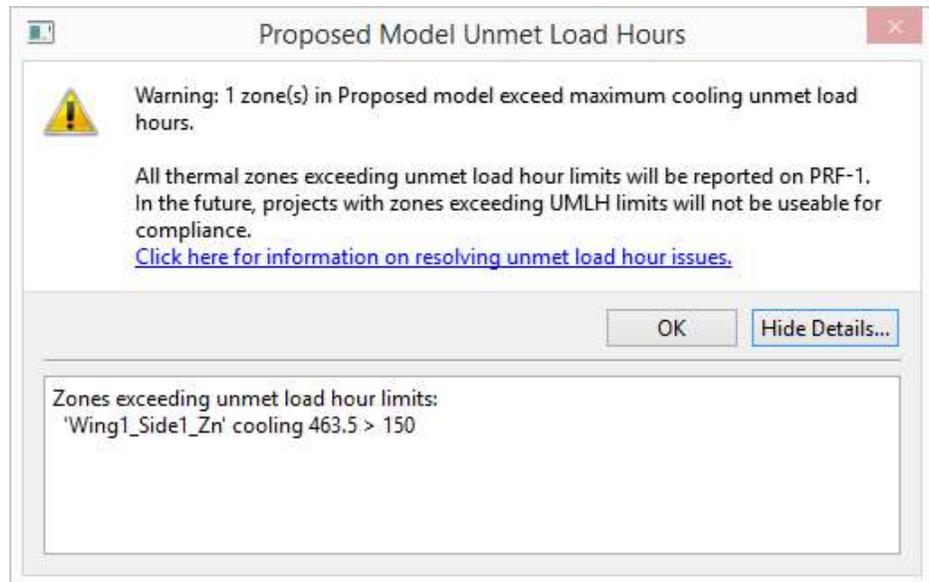
where:

- `pszBEMBasePathFile` is a null terminated string containing the path and filename of the data model definitions file. This should not be specified (pass in NULL) unless the run being performed uses a different data model as the one previously used to initialize the DLLs or perform a simulation.
- `pszRulesetPathFile` is a null terminated string containing the path and filename of the ruleset file used to process the building model. This should be specified for each run when switching building models, as it re-initializes both the building model and ruleset data. In the CBECC-Com installer, this would be: '`<Data directory>\Rulesets\T24N_2019.bin`' for 2019 analysis.
If a simulation is to be performed on a building model already loaded into memory, then you can specify NULL for this argument.
- `pszSimWeatherPath` is a null terminated string containing path (including trailing '\') of the directory where the EnergyPlus CEC weather files reside. The default CBECC-Com installer location for these files is: '`<Data directory >\EPW\`'.
- `pszCompMgrDLLPath` is a null terminated string containing path (including trailing '\') of the directory where the CEC compliance manager DLLs reside. If NULL or a zero-length path is specified for this argument, then the path to the executable file which loaded & called this analysis routine will be used. The analysis mechanism assumes that other required executables are located as follows in relation to the directory identified by this argument:
 - EnergyPlus simulation executable & DLLs located in 'EPlus\' subdirectory, and
 - CSE engine executable located in 'CSE\' subdirectory (used for photovoltaic panel, battery & residential water heating).
- `pszDHWWWeatherPath` (no longer used)
- `pszProcessingPath` is a null terminated string containing the path (including trailing '\') of the directory where the simulation inputs and outputs will be written.
- `pszModelPathFile` is a null terminated string containing the path and filename of the building model input (.cibd or .xml) file. The model input file identified by this argument may or may not be loaded into memory during the analysis processing depending on a subsequent argument.
- `pszLogPathFile` is a null terminated string containing the path and filename of a file to write processing messages to. If specified as NULL (which it typically is), then the log file will be equivalent to the `pszModelPathFile` specified in the previous argument, but with the file extension replaced with '.log'.
- `pszUIVersionString` is a null terminated string containing the name and version/ID of the application that is calling this function. This information is stored in the data model for later reporting in results export and final compliance reports.

- `bLoadModelFile` is a boolean indicating whether or not to read the building model (`pszModelPathFile`) into memory prior to analysis. This should be specified as 'true' (non-zero) unless the calling application has already loaded the building model into memory via a previous call.
- `pszAnalysisOptionsCSV` is a null terminated, comma separated value (CSV) formatted string defining any/all of the following analysis options:
 - `StoreBEMDetails`: boolean (0/1 – default 0): whether or not to store detailed building energy model ('.ibd-detail') files during the course of the model defaulting and analysis. Typically set to 1 in testing/debugging phases and turned off (value of 0, the default) for distribution to users (reducing processing time and file I/O).
 - `Verbose`: boolean (0/1 – default 0): whether or not to write messages to the log file for each rule evaluated on the model and identifying each step in the analysis sequence. Typically set to 1 in certain testing/debugging phases and turned off (value of 0, the default) for distribution to users (reducing processing time and file I/O – can result in very large analysis log files).
 - `Silent`: boolean (0/1 – default 0): whether or not dialog boxes are permitted to be presented during the analysis. One example is a dialog indicating that a file needing to be written during/following the analysis cannot be written to, prompting the user to close the file in another application it is opened in so that the file can be re-written. A value of '1' will prevent user prompts and issues such as files unable to be written may cause the analysis to be aborted.
 - `PreAnalysisCheckPromptOption`: integer (0-3 – CBECC UI default 3, API/batch default 0): whether or how to alert user of issues detected during PreAnalysis checks (further described below). Options include:
 0. no user prompt / abort analysis if errors are detected, otherwise continue analysis (regardless of any warnings)
 1. no user prompt / abort analysis if either pre-analysis errors OR warnings are detected
 2. abort analysis with no user prompt if pre-analysis errors are detected / prompt user to continue or abort analysis if warnings are detected
 3. prompt user if any pre-analysis errors or warnings are detected (w/ option to continue or abort if warnings but no errors detected)



- PromptUserUMLHWarning: boolean (0/1 – default 0): whether or not to prompt user with a dialog following simulation of the Proposed model if any thermal zones are found to exceed the unmet load hour (UMLH) limits as prescribed in the compliance ruleset. The dialog looks like this:



where the “Click here...” link opens the CBECC-Com HVAC FAQ page at the UMLH section in the user’s default web browser.

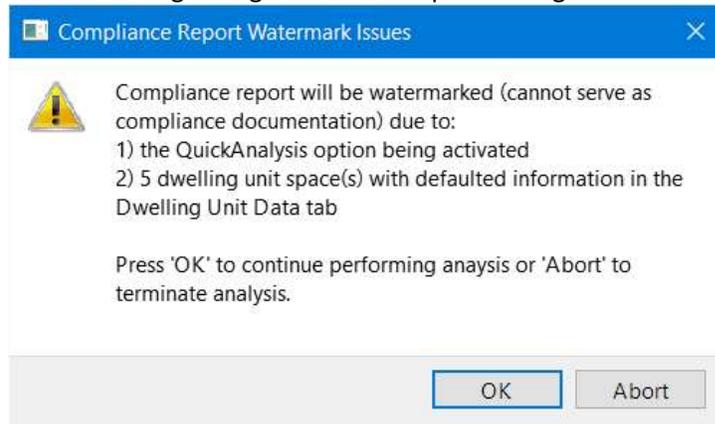
- WriteUMLHViolationsToFile: boolean (0/1 – default 1): whether or not to write a text file with details of any Proposed model unmet load hours (similar to the information provided in the above dialog). If selected, this information is written to the file:
`<Input file path>\<Input filename> - UMLH Zones.txt`
- QuickAnalysis (-1/0/1 – default -1): whether to perform QuickAnalysis, processes much faster but may vary from the results of a full annual analysis and therefore cannot be used to generate final compliance documentation. There is no difference in the sizing simulations, but annual simulations consist of 4 1-week run periods, one period simulated in each season of the year. Values of 0/1 will override the QuickAnalysis setting defined in the model input data and the default value of -1 will activate QuickAnalysis only if specified in the model.
- ParallelSimulations: boolean (0/1 – default 1): whether or not simulations should be grouped by type (sizing vs. annual) and performed at the same time (in parallel). This feature has been shown to reduce the overall analysis duration by 30-40% (depending on model details). This feature can be toggled off by specifying a '0' for this analysis option.
- LogWritingMode: integer (0-2 – default 2): the method used to write messages to project log files.
 0. log file flushed and closed following each write (slower, but ensures complete log file)
 1. log file populated in memory and only flushed/refreshed periodically (faster writing)
 2. causes use of method '1' if any detailed logging activated (when VerboseInputLogging, LogRuleEvaluation, or DebugRuleEvalCSV are specified), otherwise '0'
- AnalysisThruStep: integer (0-100 – default 100): an indication of the last analysis step to be executed before aborting the analysis. Steps of the analysis (and their corresponding integer values) include:
 1. Analysis initialization (DEFAULT/CHECKSIM/CHECKCODE rules)
 2. Prepare Proposed & Baseline Sizing models (if applicable)

3. Generate Proposed & Baseline Sizing model OSM (OpenStudio Model) and IDF (EnergyPlus Input) files (if applicable)
 4. Simulate Proposed & Baseline Sizing models and retrieve results (possible iteration of sizing runs)
 5. Generate Annual Proposed & Baseline models
 6. Generate Annual Proposed & Baseline model OSM (OpenStudio Model) and IDF (EnergyPlus Input) files
 7. Simulate Annual Proposed & Baseline models, retrieve results and perform UMLH (unmet load hours) check
 8. Generation of compliance report
- DontAbortOnErrorsThruStep: integer (0-100 – default 0): an indication of how far the analysis sequence (based on the steps listed above) should be executed, regardless of the number or types of errors encountered through that point.
 - BypassInputChecks: boolean (0/1 – default 0): whether or not numeric range and required input checks should be bypassed during the course of performing the analysis. This is typically activated (set to 1) only when performing software testing/debugging and a certified compliance report cannot be generated when set to 1.
 - BypassUMLHChecks: boolean (0/1 – default 0): whether or not UMLH (unmet load hour) checks should be bypassed during the course of performing the analysis. This is typically activated (set to 1) only when performing software testing/debugging and a certified compliance report cannot be generated when set to 1.
 - **BypassPreAnalysisCheckRules: boolean (0/1 – default 0): whether or not PreAnalysisCheck rules (intended to warn users if an analysis may not generate a valid/permit compliance report) should be bypassed during the course of performing the analysis. This is typically activated (set to 1) only when performing software testing/debugging and a certified compliance report cannot be generated when set to 1.**
 - BypassCheckSimRules: boolean (0/1 – default 0): whether or not CheckSim rules (designed to ensure that the building model as input can be simulated) should be bypassed during the course of performing the analysis. This is typically activated (set to 1) only when performing software testing/debugging and a certified compliance report cannot be generated when set to 1.
 - BypassCheckCodeRules: boolean (0/1 – default 0): whether or not CheckCode rules (designed to ensure that mandatory code requirements are present in the building model) should be bypassed during the course of performing the analysis. This is typically activated (set to 1) only when performing software testing/debugging and a certified compliance report cannot be generated when set to 1.
 - BypassOpenStudio_zp / BypassOpenStudio_zb / BypassOpenStudio_ap / BypassOpenStudio_ab: boolean (0/1 – default 0): whether or not OpenStudio (and the EnergyPlus simulation) is to be bypassed for the proposed sizing ('_zp'), baseline sizing ('_zb'), proposed ('_ap') and/or baseline ('_ab') models. This is typically activated (set to 1) only when performing software testing/debugging and a certified compliance report cannot be generated when set to 1.
 - OverrideAutosize_zp / OverrideAutosize_bz / OverrideAutosize_ap / OverrideAutosize_ab: integer (-1/0/1 – default -1): whether to force the simulation to automatically size (autosize) the HVAC equipment ('1'), to not autosize the equipment ('0') or to simulate using the default autosizing setting ('-1' => off for Annual Proposed & Baseline, on for Proposed & Baseline Sizing). This is typically activated (set to 0 or 1) only when performing software

testing/debugging and a certified compliance report cannot be generated when set to a value other than -1.

- IgnoreFileReadErrors: boolean (0/1 – default 0): whether or not the analysis should ignore (continue analysis following) errors encountered when reading and parsing the input building model.
- PurgeUnreferencedObjects: boolean (0/1 – default 1): whether or not purge (delete) building objects from the model that have no effect on the analysis during the early stages of rule processing.
- EnableRptGenStatusChecks: boolean (0/1 – default 1): whether or not to check for report generator website access prior to initiating report generation.
This feature is known to have problems in some network/proxy server scenarios, in which case it is important to disable this option in order to ensure that reports are generated.
- ComplianceReportPDF: boolean (0/1 – default 0): whether or not a PDF compliance report will be generated at the conclusion of the analysis, assuming no errors have occurred and no checks or simulation runs were bypassed. In the event a compliance PDF is generated, the file will be located in the project directory and named:
 <project file name> - AnalysisResults-BEES.pdf
This option can also be toggled on by setting Proj:CompReportPDF to '1' in the input building model.
- ComplianceReportXML: boolean (0/1 – default 0): whether or not a full (XML) compliance report will be generated at the conclusion of the analysis, assuming no errors have occurred and no checks or simulation runs were bypassed. Full XML compliance reports include all analysis inputs and results as well as an imbedded PDF report. In the event a XML compliance report is generated, the file will be located in the project directory and named:
 <project file name> - AnalysisResults-BEES.xml
This option can also be toggled on by setting Proj:CompReportXML to '1' in the input building model.
- CompReportWarningOption: integer (0-5 – default 0): determines whether the analysis is to be aborted in cases where a compliance report is selected for output but either the report generator is not available or there are project or analysis settings that would cause the report to be watermarked (and therefore could not serve as compliance documentation). This value also determines whether or not a dialog is presented by the compliance engine enabling the user to continue or abort the analysis when these situations are encountered. Options include:
 - 0. No user prompt - continue analysis regardless of compliance report issues
 - 1. No user prompt - abort analysis if report generation is not available and continue analysis if report is available but will be watermarked
 - 2. No user prompt - abort analysis if either report generation is unavailable or the report will be watermarked
 - 3. Prompt user when report generation is not available and continue analysis without prompting user if the report will be watermarked
 - 4. Abort analysis with no user prompt if report generation is not available and prompt user if the report will be watermarked
 - 5. Prompt user if either report generation is not available or if the report will be watermarked

Here is an example of how the warning dialog from the compliance engine looks:



- SimulationStorage: integer (0-7 – default 1): determines which, if any, simulation input and/or output files are to be retained following each building model simulation. Valid options include:
 - 0. ALL simulation sub-directories and files deleted
 - 1. Only the input (.idf) files are retained
 - 2. (#1 above) + summary output (.htm) retained
 - 3. (#2 above) + limited additional output (.csv | .eio | .err | .rdd) retained
 - 4. (#3 above) + SQL output (.sql) retained
 - 5. (#3 (not 4) above) + both SQL & other standard output files retained
 - 6. (#4 & 5 above) +
 - 7. ALL simulation input and output files retained
- AnalysisStorage: integer (0-3 – default 2): determines which, if any, (non-simulation) files generated during analysis are to be retained following each round of analysis. Valid options include:
 - 0. ALL analysis files deleted
 - 1. Only simulation SDD XML (.xml) files are retained
 - 2. (#1 above) + OpenStudio model (.osm) files are retained
 - 3. ALL files produced during analysis are retained
- ExportHourlyResults: a series of integer options that will cause the export of 1-2 hourly results CSV files during analysis, one for each individual annual simulation.
 - ExportHourlyResults_ap = 1 - exports results of annual proposed simulation
 - ExportHourlyResults_ab = 1 - exports results of annual baseline simulation
 - ExportHourlyResults_All = 1 - exports results of all annual simulations
- ProxyServerAddress: character string: The address (i.e. “site.site:port”) of the proxy server to be used in accessing the report generator (via the internet).
- ProxyServerCredentials: character string: Username and password credentials (i.e. “username:password”) needed to access the internet via the proxy server (only needed for report generation).
- ProxyServerType: character string: options include ‘Http’ (default), ‘Socks5’, ‘HttpCaching’ and ‘FtpCaching’.
- NetComLibrary: character string: network communications software library – options include ‘QT’ (new default in this version), and ‘CURL’ (only option in previous releases).
- ModelRpt_ALL (or specific model report options): boolean (0/1 – default 0): whether or not certain CSV report files are to be written by the ruleset for each model generated during the analysis. Such CSV files are used primarily for testing/debugging, but can be informative in

comparing certain aspects of the analysis models. The ModelRpt_ALL can be specified to activate all defined reports, or individual report options can be specified as:

ModelRpt_Space_InteriorLoadsElec (self explanatory)
ModelRpt_Space_InteriorLoadsFuel

Multiple analysis options can be concatenated into the pszAnalysisOptionsCSV string, for instance, if you wanted to perform a run with the Verbose & BypassOpenStudio_p flags activated (and all other defaults used), then this function argument would include the string "Verbose,1,BypassOpenStudio_p,1,".

Searches for options in this string argument are case insensitive and if a single flag is repeated multiple times, the value associated with its first occurrence will drive the analysis.

- pszErrorMessage is a pointer to a character string that can be populated by this function to describe error(s) encountered during the analysis. Pass in a value of 0/NULL if no return of error messaging is desired.
- iErrorMsgLength is an integer describing the number of characters present in the error message character string (previous argument). Pass in a value of 0 if no return of error messaging is desired.
- bDisplayProgress is a boolean indicating whether or not to display the analysis progress dialog as the processing is executed.
- hWnd is a HANDLE to a MS Windows application window. This argument is not currently used.
- pszResultsSummary is a pointer to a character string of length (iResultsSummaryLen) that is to be populated with a summary of the analysis performed. If no results summary string is desired, pass NULL for this argument.
- iResultsSummaryLen is the length of the character string (pszResultsSummary argument) to be populated (2056 is recommended length), or 0 if no summary string desired. Refer to information below for the CMX_PopulateResultsHeader_CECNonRes() function for information about populating column titles for this data.
- iSecurityKeyIndex is an integer value assigned to each certified software vendor that is used to identify which of a predefined number of security keys integrated into the compliance ruleset should be used to generate permit (secure) compliance reports immediately following the analysis. Contact the CEC and/or compliance engine software contractor for this index prior to submitting software to the CEC for certification.
- pszSecurityKey is a null terminated string containing a subset of a private security key which is used by the compliance engine to generate permit (secure) compliance reports immediately following the analysis. Contact the CEC and/or compliance engine software contractor for this character string prior to submitting software to the CEC for certification.

Return value is 0 if simulation successful and > 0 if errors occurred (listed below).

Call this routine once for each compliance analysis to be performed.

All path/filename arguments can be either complete or relative to the path in which the calling executable resides.

Error return value mapping:

1 : pszBEMBasePathFile doesn't exist

- 2 : pszRulesetPathFile doesn't exist
- 3 : pszSimWeatherPath doesn't exist
- 4 : pszCompMgrDLLPath specified, but doesn't exist
- 5 : Invalid project log file name (too long)
- 6 : Error writing to project log file
- 7 : Building model input/project file not found
- 8 : Error reading/initializing model input/project file
- 9 : Errors encountered evaluating input model defaulting rules
- 10 : Errors encountered evaluating input model defaulting rules (multiple times)
- 11 : Error(s) encountered performing required data & numeric range checks
- 12 : Error(s) encountered checking input model for simulation compatibility
- 13 : Error(s) encountered checking input model for code requirements
- 14 : Error encountered initializing weather file locations and/or names
- 15 : Error creating or accessing the analysis processing directory
- 16 : Error generating Proposed Sizing model
- 17 : Error generating Proposed (final) model
- 18 : Error generating Standard Sizing model
- 19 : Error generating Standard (final) model
- 20 : Error initializing Standard Sizing model
- 21 : Error initializing Standard (final) model
- 22 : Analysis aborted - user chose not to overwrite SDD XML file
- 23 : Error: Unable to write SDD XML file
- 24 : Error(s) encountered simulating Proposed model
- 25 : Error(s) encountered simulating Standard Sizing model
- 26 : Error(s) encountered simulating Standard (final) model
- 27 : Error(s) encountered retrieving Proposed model simulation results
- 28 : Error(s) encountered retrieving Standard Sizing model simulation results
- 29 : Error(s) encountered retrieving Standard (final) model simulation results
- 30 : Proposed model zone(s) exceed unmet load hours limits
- 31 : Error initializing building model database
- 32 : Error loading analysis ruleset
- 33 : User aborted analysis via progress dialog 'Cancel' button
- 34 : Invalid results object types
- 35 : Error copying results objects from a previous model
- 36 : Error copying equipment sizes/flows from source model
- 37 : Error(s) encountered reading building model (input/project) file
- 38 : Error: EnergyPlus simulation engine not found.
- 39 : Error: Version of EnergyPlus installed not compatible with analysis.
- 40 : Error setting up check of weather & design day file hashes
- 41 : DHW simulation not successful
- 42 : Error encountered in creating building geometry
- 43 : Error encountered initializing building geometry DBIDs
- 44 : Error initializing Proposed model
- 45 : Error(s) encountered simulating Proposed Sizing model
- 46 : Error(s) encountered retrieving Proposed Sizing model simulation results
- 47 : Error encountered in generating window shades
- 48 : UseExcptDsgnModel flag set but no path/filename specified by UseExcptDsgnModel
- 49 : IDF path/filename specified by Proj:UseExcptDsgnModel not found

- 50 : Exceptional Design IDF specification and the Quick Analysis feature cannot both be activated
- 51 : Window(s) and/or Door(s) are overlapping on ExtWalls with window shades defined
- 52 : Analysis aborted via callback function in calling application
- 53 : Input model contains one or more objects with the same name
- 54 : CSE (recirculation DHW simulation engine) executable(s) not found
- 55 : CSE (recirculation DHW simulation engine) use profile file not found
- 56 : CSE (recirculation DHW simulation) Day Use Type (Proj:CSE_DHWUseMthd) invalid
- 57 : Unable to copy DHW Use/Load Profile CSE include file into processing directory
- 58 : Unable to open/delete/write simulation input (.cse) file
- 59 : Error writing simulation input (.cse) file
- 60 : Unable to open/delete/write simulation weather file
- 61 : Error copying simulation weather file to processing directory
- 62 : Unable to open/delete/write simulation output file (.csv or .rep)
- 63 : Error evaluating CSE_SimulationPrep rules
- 64 : Unable to open/delete/write CSE include file
- 65 : Error copying simulation weather file to processing directory
- 66 : Analysis aborted - user chose to abort due to compliance reporting issue(s)
- 67 : Error evaluating ProposedModelPrep rules
- 68 : One or more errors returned from Compliance Report Generator
- 69 : Error evaluating rulelist that converts residential DHW systems to code baseline
- 70 : Error evaluating 'GenerateZEROCodeReport' rulelist
- 71 : Error(s) encountered performing pre-analysis check of input model
- 72 : Error in sizing small central residential HPWH system(s) using CSE
- 73 : EnergyPlus IDF path/filename too long
- 74 : Error copying EnergyPlus simulation input file to processing directory
- 75 : Error copying EnergyPlus simulation weather file to processing directory
- 76 : Error evaluating 'AnalysisPostProcessing' rulelist

(return values in the range greater than 100 describe issues encountered during/by simulation)

101-110 describe issues not specific to any individual run:

- 101 : User aborted analysis
- 102 : Simulation processing path not valid
- 103 : Simulation executable path not valid
- 104 : Invalid number of concurrent simulations (max = 10)
- 105 : Invalid combination of unique model & quick simulations (max 2 models when performing quick runs)

111-310 describe issues with initializing simulation inputs (SimIdx = 0-9):

- 111 + (SimIdx*10) : SDD XML simulation input file not found
- 112 + (SimIdx*10) : Simulation weather file not found
- 113 + (SimIdx*10) : Simulation error output path/file not valid
- 114 + (SimIdx*10) : Invalid simulation input data

311-510 describe errors encountered in OpenStudio processing (SimIdx = 0-9):

- 311 + (SimIdx*10) : Error encountered in OpenStudio loading SDD XML file
- 312 + (SimIdx*10) : Error encountered in OpenStudio saving model to OSM file
- 313 + (SimIdx*10) : Unable to locate EnergyPlus simulation SQL output file
- 314 + (SimIdx*10) : OpenStudio Model not valid following simulation
- 315 + (SimIdx*10) : OpenStudio Facility not valid following simulation
- 316 + (SimIdx*10) : Error creating OpenStudio Model object
- 317 + (SimIdx*10) : Error encountered in OpenStudio saving (forward translated) IDF file

511-610 describe errors encountered in EnergyPlus simulation (SimIdx = 0-9):

511 + (SimIdx*5) : Fatal error(s) occurred in EnergyPlus simulation

512 + (SimIdx*5) : EnergyPlus simulation did not complete successfully

```
int CMX_PerformAnalysisCB_NonRes (
    const char* pszRulesetPathFile,
    const char* pszCompMgrDLLPath,
    const char* pszProcessingPath,
    const char* pszLogPathFile,
    bool bLoadModelFile,
    char* pszErrorMessage,
    bool bDisplayProgress,
    char* pszResultsSummary,
    int iSecurityKeyIndex,
    PAnalysisProgressCallbackFunc pAnalProgCallbackFunc );
    const char* pszBEMBasePathFile,
    const char* pszSimWeatherPath,
    const char* pszDHWeatherPath,
    const char* pszModelPathFile,
    const char* pszUIVersionString,
    const char* pszAnalysisOptionsCSV,
    int iErrorMsgLength,
    int iResultsSummaryLen,
    const char* pszSecurityKey,
    PAnalysisProgressCallbackFunc );

// typedef int (__cdecl *PCMX_PerformAnalysisCB_NonRes)( const char*,
//
//               const char*, const char*, const char*,
//               const char*, const char*, const char*,
//               const char*, const char*, bool,
//               const char*, char*, int, bool, char*, int, int,
//               const char*, PAnalysisProgressCallbackFunc );
// _CMX_PerformAnalysisCB_NonRes
```

This is an alternative compliance analysis routine as the one listed above (CMX_PerformAnalysis_CECNonRes). The function arguments are identical to the above routine with the exception of HWND* removed and a new final argument which is a pointer to a callback function. The return value is also the same as above.

This callback function referenced by the final function argument is called each time the analysis progress is checked/reported, enabling calling applications to monitor analysis progress and abort analysis prior to completion without using the analysis progress dialog available in the compliance engine.

where:

- (refer to the previous routine for information on all arguments prior to pAnalProgCallbackFunc)
- pAnalProgCallbackFunc is a pointer to a callback function declared as:

```
long (CALLBACK* PAnalysisProgressCallbackFunc)( long lProgressID,
                                                long lPercent )
```

where:

lProgressID encodes several settings describing the current stage of analysis (see below), and

lPercent which indicates the percent progress (0-100)

A return value of 0 from the callback function will cause analysis to continue and a return value > 0 will cause the analysis to be aborted.

The following source code describes how the lProgressID argument can be decoded to describe the current analysis stage.

```
//      2,147,483,647 - max long int
//      ABB,CCC,CDD - compliance analysis

#define BCM_NRP_AMult 100000000
#define BCM_NRP_BMult 1000000
#define BCM_NRP_CMult 100
```

```

#define BCM_NRP_EMult      10000
#define BCM_NRP_ComplianceProgressID( lAnalType, lAnalStep, lModels, lSimProg )
    (long) ( (lAnalType * BCM_NRP_AMult) + (lAnalStep * BCM_NRP_BMult) +
            (lModels * BCM_NRP_CMult) + lSimProg )

// A: analysis type
#define BCM_NRP_Type_Comp      0      //      0-compliance
#define BCM_NRP_Type_Batch    1      //      1-batch processing
#define BCM_NRP_Type( lNRP )  (long) (lNRP / BCM_NRP_AMult)
#define BCM_NRP_TypeIsComp( lNRP )
    (long) (BCM_NRP_Type( lNRP ) == BCM_NRP_Type_Comp ? 1 : 0)
#define BCM_NRP_TypeIsBatch( lNRP )
    (long) (BCM_NRP_Type( lNRP ) == BCM_NRP_Type_Batch ? 1 : 0)

// B: analysis step - valid range 0-99
#define BCM_NRP_Step_None     0      //      0-blank
#define BCM_NRP_Step_Init     1      //      1-Initialization
#define BCM_NRP_Step_Read     2      //      2-Read/Parse Input
#define BCM_NRP_Step_MPrep    3      //      3-Preparing Model(s)
#define BCM_NRP_Step_MTrans   4      //      4-Translating Model(s)
#define BCM_NRP_Step_MSim     5      //      5-Simulating Model(s)
#define BCM_NRP_Step_MSimRes  6      //      6-Simulation Results
#define BCM_NRP_Step_Store    7      //      7-Store Model & Result
#define BCM_NRP_Step_Report   8      //      8-Report Generation
#define BCM_NRP_Step_Done     9      //      9-Completed
#define BCM_NRP_Step( lNRP )  (long) ((lNRP - ((lNRP / BCM_NRP_AMult) *
    BCM_NRP_AMult)) / BCM_NRP_BMult)

// C: bitwise flags for up to 13 individual models
//      0 - none
// 0 0000 0000 0001 - u / user input model      (not used in compliance runs)
// 0 0000 0000 0010 - zp / sizing proposed model
// 0 0000 0000 0100 - zb / sizing baseline model
// 0 0000 0000 1000 - ap / annual proposed model
// 0 0000 0001 0000 - ab / annual baseline model
#define BCM_NRP_Model( lNRP ) (long) ((lNRP - ((lNRP / BCM_NRP_BMult) *
    BCM_NRP_BMult)) / BCM_NRP_CMult)

// int BCM_NRP_NumModels( int iModels )          - defined in .cpp
// int BCM_NRP_NumProgressModels( long lNRP )    - defined in .cpp
#define BCM_NRP_Model_None    0      // 0-none
// generic models 1-13
#define BCM_NRP_Model_1      1
#define BCM_NRP_Model_2      2
#define BCM_NRP_Model_3      4
#define BCM_NRP_Model_4      8
#define BCM_NRP_Model_5     16
#define BCM_NRP_Model_6     32
#define BCM_NRP_Model_7     64
#define BCM_NRP_Model_8    128

```

```

#define BCM_NRP_Model_9      256
#define BCM_NRP_Model_10    512
#define BCM_NRP_Model_11    1024
#define BCM_NRP_Model_12    2048
#define BCM_NRP_Model_13    4096
// model names from CA non-res rules
#define BCM_NRP_Model_u      1 // user model
#define BCM_NRP_Model_zp     2 // proposed sizing
#define BCM_NRP_Model_zb     4 // baseline sizing
#define BCM_NRP_Model_ap     8 // proposed annual
#define BCM_NRP_Model_ab    16 // baseline annual

```

Mid-simulation progress described below is a placeholder for future progress reporting. These settings are not yet used in the compliance engine.

```

// D: simulation progress - valid range 0-99
#define BCM_NRP_Prog( lNRP ) (long) (lNRP % BCM_NRP_CMult)
#define BCM_NRP_Prog_None    0 // blank
#define BCM_NRP_Prog_Init    1 // Initialization
#define BCM_NRP_Prog_Warmup  2 // Warmup
#define BCM_NRP_Prog_Jan     3 // Jan
#define BCM_NRP_Prog_Feb     4 // Feb
#define BCM_NRP_Prog_Mar     5 // Mar
#define BCM_NRP_Prog_Apr     6 // Apr
#define BCM_NRP_Prog_May     7 // May
#define BCM_NRP_Prog_Jun     8 // Jun
#define BCM_NRP_Prog_Jul     9 // Jul
#define BCM_NRP_Prog_Aug    10 // Aug
#define BCM_NRP_Prog_Sep    11 // Sep
#define BCM_NRP_Prog_Oct    12 // Oct
#define BCM_NRP_Prog_Nov    13 // Nov
#define BCM_NRP_Prog_Dec    14 // Dec
#define BCM_NRP_Prog_Rpt    15 // Reporting

```

```

void CMX_GenerateReport_Proxy_CEC( const char* pszXMLResultsPathFile,
    const char* pszCACertPath,      const char* pszReportName,
    const char* pszAuthToken1,      const char* pszAuthToken2,
    const char* pszSignature,        const char* pszPublicKey,
    const char* pszProxyAddress,     const char* pszProxyCredentials,
    const char* pszDebugBool,        bool bVerbose,      bool bSilent,
    const char* pszCompRptID,        const char* pszRptGetServer,
    const char* pszRptGenApp,        const char* pszRptGenService,
    const char* pszSecKeyRLName,     const char* pszOutputPathFile,
    const char* pszProxyType,        const char* pszNetComLibrary,
    bool bSchemaBasedRptGen );

```

```

// typedef int (__cdecl *PCMX_GenerateReport_Proxy_CEC)( const char*,
//                                                         const char*, const char*, const char*, const char*,

```

```

//          const char*, const char*, const char*, const char*,
//          const char*, bool, bool, const char*, const char*,
//          const char*, const char*, const char*, const char*,
//          const char*, const char*, bool );
// _CMX_GenerateReport_Proxy_CEC

```

where:

- `pszXMLResultsPathFile` is a null terminated string containing the path and filename of the analysis results XML file. This is typically: <Project file directory>\<project file name> - AnalysisResults.xml
- `pszCACertPath` is a null terminated string containing the path (only) of the CA cert bundle (curl-ca-bundle.crt) used to verify server certificates. For CBECC-Res, this file is distributed in the main program directory.
- `pszReportName` is a null terminated string containing the name of the report to be generated. Valid report names currently include:
 - “NRCC_PRF_01” (2013 Certificate of Compliance - Nonresidential Perf...)
 - “NRCC_PRF_0116” (2016 Certificate of Compliance - Nonresidential Perf...)
 - “NRCC_STD_0116” (2016 Compliance report describing Standard Design model)
 - “NRCC_PRF_0119” (2019 Certificate of Compliance - Nonresidential Perf...)
 - “NRCC_STD_0119” (2019 Compliance report describing Standard Design model)
- `pszAuthToken1` is a null terminated string that, combined with `AuthToken2`, identifies the calling application. This argument is set to “CBECC-Com” for CBECC-Com and may vary for other certified products.
- `pszAuthToken2` is a null terminated string that, combined with `AuthToken1`, identifies the calling application version. **This argument is currently set to “1” for 2019.1.0, but will change with each major software release.**
- `pszSignature` is a null terminated string containing the base-64 ASCII-encoded signature used to sign request data. Signature processing is not yet implemented, so for the time being the string “none” should be supplied for this argument.
- `pszPublicKey` is a null terminated string containing the base-64 ASCII-encoded public key used to sign request data. Signature processing is not yet implemented, so for the time being the string “none” should be supplied for this argument.
- `pszProxyAddress` is a null terminated string containing the address (i.e. “site.site:port”) of the proxy server to be used in accessing the report generator (via the internet). If no proxy server is needed/used for internet access, then pass NULL for this argument.
- `pszProxyCredentials` is a null terminated string containing the username and password credentials (i.e. “username:password”) needed to access the internet via the proxy server. If no proxy server is needed/used for internet access or if no username/password credentials are needed in conjunction with the proxy server, then pass NULL for this argument.
- `pszDebugBool` is a null terminated string containing either the word “true” or “false”. Passing “true” (the current default) causes the report generator to activate debugging features.
- `bVerbose` is a boolean flag (not in the form of a character string) indicating whether verbose information should be written to the project processing log file.
- `bSilent` is a boolean flag (not in the form of a character string) indicating whether or not dialog boxes are permitted to be presented during the report generation. One example is a dialog indicating that the file needing to be written to contain the compliance report cannot be written to, prompting the user to close the file in another application it is opened in or change the file permissions so that the file can be

re-written. A value of '1' will prevent user prompts and issues such as files unable to be written may cause the report generation to be aborted.

- pszCompRptID is a null terminated string containing the compliance report ID, currently specified as "BEES".
- pszRptGetServer is a null terminated string containing the compliance report generator server name, currently specified as "t24docs.com".
- pszRptGenApp is a null terminated string containing the compliance report generator application, currently specified as "ReportGeneratorCom".
- pszRptGenService is a null terminated string containing the compliance report generator service, currently specified as "ReportingService.svc".
- pszSecKeyRLName is a null terminated string containing the compliance report security key rulelist name, currently specified as "rl_SECURITYKEYS".
- pszOutputPathFile is a null terminated string containing the path and filename of the file to store the compliance report to. If not specified, then the default output file will be used:
"analysis results filename>-BEES.PDF" (or .XML, depending on the ... argument)
- pszProxyType is a null terminated string describing the type of proxy server. Options include 'Http' (default), 'Socks5', 'HttpCaching' and 'FtpCaching'.
- pszNetComLibrary is no longer used (only NetComLibrary option is QT).
- **bschemaBasedRptGen** is a boolean flag indicating whether the analysis output report is controlled by a schema, which effects the URL used to communicate with the report generator. This is currently set to 'true' only for new CBECC-Res 2019 compliance reports (should always be 'false' for Com reporting).

Error return value mapping:

- 1 : XML file not found
- 2 : CACert file not found
- 3 : Error opening and/or reading the analysis results XML file
- 4 : Error allocating memory for XML file storage
- 5 : User chose not to overwrite output report file
- 6 : Error opening report output file
- 7 : Error reading analysis results XML file
- 8 : Error reading analysis results XML file
- 9 : Error initializing CURL (curl_easy_init() returned NULL)
- 10 : Report generation processing error in send request
- 11 : Report generation processing error in result retrieval
- 12 : No Report Name specified
- 13 : Missing or invalid PDF Only boolean string (must be 'true', 'false', 'both' or a Component:Property name (case insensitive))
- 14 : Missing or invalid report generation debug boolean string (must be 'true' or 'false' (case insensitive))
- 15 : Missing or invalid AuthToken1 string
- 16 : Missing or invalid AuthToken2 string
- 17 : Missing or invalid Signature string
- 18 : Missing or invalid PublicKey string
- 19 : Error opening output file following report generation
- 20 : Error reading data from output file following report generation
- 21 : PDF report contains XML data - likely error messages from web server

- 22 : XML Path not specified
- 23 : CACert path not specified
- 24 : CACertPath not a valid or found directory
- 25 : Error converting results file signature to hexadecimal
- 26 : Error extracting PDF from compliance report XML

```
int CMX_PopulateResultsHeader_CECNonRes( char* pszHdr1, int iHdr1Len,
                                         char* pszHdr2, int iHdr2Len, char* pszHdr3, int iHdr3Len );

// typedef int ( __cdecl *PCMX_PopulateResultsHeader_CECNonRes)
//           ( char*, int, char*, int, char*, int );
// _CMX_PopulateResultsHeader_CECNonRes
```

where:

- pszHdr1, pszHdr2 & pszHdr3 are pointers to character string of length iHdr1/2/3Len that are to be populated with column labels for analysis results summaries returned via the final two arguments of the `CMX_PerformAnalysis_CECNonRes()` function.
- iHdr1Len, iHdr2Len & iHdr3Len are the lengths of the character string arguments to be populated. Current recommended label string lengths are **768**, 1024 & **3072**, respectively

Return value is 0 if all header strings are populated successfully and a value of 1-3 if population of one of the three header strings is not successful.

```
int CMX_GetDataString( char* sReturnStr, int iRetStrLen, const char* pszCompParam,
                      const char* pszCompName, BOOL bAddCommas,
                      int iPrecision, const char* pszDefault );

// typedef int ( __cdecl *PCMX_GetDataString)( char*, int, const char*,
//                                           const char*, BOOL, int, const char* );
// _CMX_GetDataString
```

where:

- sReturnStr is a character string buffer to be populated with data from the building model.
- iRetStrLen is the number of characters allocated in the sReturnStr buffer. The returned string will be null-terminated, so the maximum number of characters written to sReturnStr will be (iRetStrLen-1).
- pszCompParam is a null-terminated string identifying the model object and property to return a string representation of. This argument can reference properties of any type in the data model (float, integer, object reference, enumeration or string). The object name and property name are separated by a colon, so this argument would contain 'Proj: CondFloorArea' to return a string-representation of the CondFloorArea property of the Proj (Project) object.
- pszCompName is a null terminated string containing the name of the object for which the object/property is to be returned. If there is only a single object of this type in the project (as is the case for Proj, EUseSummary and some other object types), then this argument can/should be set to NULL. If this argument is NULL for objects where multiple are present in the building model, then the property data for the "currently active" object of that type will be returned (not advised).

- `bAddCommas` is a Boolean indicating whether or not commas (or related Windows Locale-based numeric separators) are to be included in the returned string. This argument is only referenced when returning string representations of integer or float object properties.
- `iPrecision` is an integer indicating the decimal precision to be used when populating the return string of float properties. Ignored for non-float properties.
- `pszDefault` is a null-terminated string containing the desired return string in the event the `Object:Property` being retrieved is not defined in the building model.

Return value is 0 if data retrieval is successful and > 0 if errors occurred.
 <error return value info to be supplied at a later date>

Call this routine each time string data is to be retrieved from the building model.

```
int CMX_GetDataInteger( long* pReturnInt,  const char* pszCompParam,
                        const char* pszCompName,  long lDefault );

// typedef int  (__cdecl *PCMX_GetDataInteger)( long*,  const char*,
//                                             const char*,  long );
// _CMX_GetDataInteger
```

where:

- `pReturnInt` is a pointer to a (32-bit) integer to be populated with data from the building model.
- `pszCompParam` is a null-terminated string identifying the model object and property to return the value of. This argument can only reference properties of integer or enumeration types in the data model. The object name and property name are separated by a colon in this string argument.
- `pszCompName` is a null terminated string containing the name of the object for which the object/property is to be returned. If there is only a single object of this type in the project (as is the case for Proj, EUseSummary and some other object types), then this argument can/should be set to NULL. If this argument is NULL for objects where multiple are present in the building model, then the property data for the “currently active” object of that type will be returned (not advised).
- `lDefault` is a 32-bit integer value which will be returned (via the `pReturnInt` argument) in the event the `Object:Property` being retrieved is not defined in the building model.

Return value is 0 if data retrieval is successful and > 0 if errors occurred.
 <error return value info to be supplied at a later date>

Call this routine each time integer data is to be retrieved from the building model.

```
int CMX_GetDataFloat(  float* pReturnFlt,  const char* pszCompParam,
                       const char* pszCompName,  float fDefault );

// typedef int  (__cdecl *PCMX_GetDataFloat)(  float*,  const char*,
//                                             const char*,  float );
// _CMX_GetDataFloat
```

where:

- `pReturnFlt` is a pointer to a (32-bit) float to be populated with data from the building model.

- `pszCompParam` is a null-terminated string identifying the model object and property to return the value of. This argument can reference properties of float, integer, enumeration or object reference types in the data model (returning a float value for an object reference property returns a 1-based index of the referenced object (among all objects of that type)). The object name and property name are separated by a colon in this string argument.
- `pszCompName` is a null terminated string containing the name of the object for which the object/property is to be returned. If there is only a single object of this type in the project (as is the case for Proj, EUseSummary and some other object types), then this argument can/should be set to NULL. If this argument is NULL for objects where multiple are present in the building model, then the property data for the “currently active” object of that type will be returned (not advised).
- `fDefault` is a 32-bit float value which will be returned (via the `pReturnFlt` argument) in the event the Object:Property being retrieved is not defined in the building model.

Return value is 0 if data retrieval is successful and > 0 if errors occurred.

<error return value info to be supplied at a later date>

Call this routine each time float data is to be retrieved from the building model.

```
int CMX_XXX(      <type> argument, ... );

    // typedef int  (__cdecl *PCMX_XXX)(  <type>, ... );
    // ?CMX_XXX@@YAHFAMPBD1M@Z
```

where:

- `pXXX` is a `xxx`.

```
void CMX_ExitBEMProcAndCmpMgrDLLs ();

    // typedef void (__cdecl *PCMX_ExitBEMProcAndCmpMgrDLLs) ();
    // _CMX_ExitBEMProcAndCmpMgrDLLs
```

Call this routine only once (following all simulations) immediately prior to unloading the DLLs.