EnergyPlus New Features Planning - FY20 Development

Each year, the EnergyPlus development team seeks input and feedback regarding new feature development for the upcoming fiscal year (FY). Features are selected based on impact, demand, effort, and available developer expertise. Input from stakeholders is a crucial component of this process, and selected stakeholders were polled for their input. The stakeholders were asked to specify up to five new features, for consideration in FY20.

The new features that were suggested were considered alongside all other requests and prioritized accordingly. Most of the requests that were rated as "high priority" or "medium priority" have been assigned to one of the three laboratories (NREL, LBNL, or ORNL) currently funded for EnergyPlus development. This does not guarantee that the feature will be implemented, since a performer will still need to be identified (from laboratory staff or a subcontractor); however, efforts will be made to implement these features in FY20.

Features considered as "low priority" will not be pursued at this time. Some requests were deemed to be out of scope for the new features task (e.g. defects, code refactoring, or performance improvements) but may be addressed as part of separately funded work.

High Priority Feature Requests

Title	Description	Requester	Assigned Lab
Condenser hot gas reheat model for rooftops, split DX AHUs, DX DOAS systems	Many equipment manufacturers offer dehumidification reheat using condenser hot gas in rooftop, split DX AHU, and DX DOAS products. In applications where active humidity control is used to control either discharge air or space air relative humidity, dehumidification reheat is required to prevent sensible overcooling. Dehumidification reheat by conventional means such as electric resistance or fossil fuel combustion heaters is costly and energy-inefficient. To confront this challenge, manufacturers have developed schemes to take heat from the DX refrigeration system condenser and use it to provide what is "free" reheat. These schemes are typically referred to as "hot gas reheat". Beyond simply using hot gas for reheat, some manufacturers have devised controls to allow dehumidification and hot gas reheat at times of high sensible load, low sensible load, or no sensible load. Currently, EnergyPlus does not provide modeling capabilities for hot gas reheat. Addition of this feature to EnergyPlus would allow engineers to evaluate these energy-efficient humidity control options. An EnergyPlus model for this feature would need to model not just the use of hot gas for free reheat, but also controls for these three dehumidification modes.	Carrier	NREL[1]

Connecting split DX AHU components to VRF refrigerant loops	One of the recent developments in the VRF field is the ability to connect terminal devices other than indoor split fan coils to a VRF refrigerant loop. These new terminal devices include Dedicated Outdoor Air System (DOAS) AHUs and roof top mounted split DX AHUs for space conditioning and ventilation. Nearly all VRF applications need ventilation. Previously, ventilation had to be provided by separate packaged rooftop type DOAS equipment since VRF indoor units cannot handle raw outdoor air directly and VRF condensing units could not serve DOAS equipment. In addition, one of the energy efficiency limitations of VRF systems is the lack of an outdoor air economizer cycle. Both challenges have now been solved. Multiple manufacturers such as Daikin, Mitsubishi, LG, and Toshiba-Carrier offer the ability to connect split DX DOAS AHUs to VRF condensing units. In addition, Toshiba-Carrier condensing units can be connected to multiple rooftop-mounted split DX AHUs that provide space conditioning and ventilation and can offer outdoor air economizer cycles. These developments extend the application of VRF systems and the energy efficiency of these systems. Currently, VRF systems in EnergyPlus only allow indoor DX fan coil terminals to be connected to a VRF refrigerant loop. This request proposal would allow terminal devices such as split DX DOAS AHUs and split DX AHUs for space conditioning and ventilation to be connected to VRF refrigerant loops.	Carrier	NREL[1]

Modeling recirculation air in DOAS AHU systems	Traditionally, Dedicated Outdoor Air System (DOAS) AHUs provide 100% outdoor air for all system operating hours. Over recent years DOAS applications have become more varied and systems with less than 100% outdoor air (and therefore recirculation air) are coming into use. One example is DOAS AHUs used to drive active chilled beams or induction beams. The primary airflow required to drive the chilled beam terminal is often larger than the Standard 62.1 ventilation requirement for the zone. DOAS AHUs providing 100% OA therefore use more outdoor air then code-required and this results in a significant energy penalty for cooling and heating. The ability to model recirculation air in these DOAS applications (i.e. OA fraction less than 1.00) would allow modeling or higher efficiency chilled beam and induction beam applications. Another example is DOAS AHUs fitted with outdoor air economizers. These systems are sized for airflow exceeding Standard 62.1 ventilation requirements. Standard 62.1 minimum OA with recirculation air is used for times of zone cooling loads but higher than room temperature outdoor air conditions. When OA drops to cooler temperatures and lower humidities, an outdoor air economizer cycle is activated to provide partial or total free cooling to the zones, thereby allowing space conditioning equipment to turn off. This scheme also increases the energy efficiency of buildings. Currently, EnergyPlus can support some applications for DOAS recirculation, but not others. This proposal seeks to allow modeling across the range of applications, controls, and equipment types in EnergyPlus.	Carrier	NREL
Enhanced LEED outdoor air reporting	Anyone seeking to use EnergyPlus for LEED work needs to document the use of outdoor air in their models. While the current Outdoor Air Summary provides some information to help these users, it does not provide enough. Users often find it difficult to compare the outdoor air delivered for proposed vs baseline simulations, especially with economizers and zone equipment. This task would expand the scope of the Outdoor Air Summary to include zone HVAC equipment, add tracking and table outputs for the minimum requested OA flow in addition to the existing output for actual OA flow, track times when the delivered OA is less than the minimum requirement, and provide outputs at standard air density.	GARD	NREL[1]
Overhaul version transition process	The version transition process is cumbersome to developers and causes issues with tools that utilize EnergyPlus. Some tools have adapted to the EnergyPlus version workflow, while others struggle to follow the process and end up becoming out of date. The transition workflow was developed nearly twenty years ago, and with a vastly different software environment available, we should be able to overhaul this into something more amenable to developers, users, and interfaces. he ultimate goal of this would be two-fold: eliminate the Fortran-based transition process and enable more nimble releases with less burden on outside tools to follow breaking changes. This task could involve deprecating IDF and moving solely to JSON input.	NREL	NREL[2]

Scheduling Minimum Airflow for VAV boxes	All inpatient and many outpatient facilities in the US and around the world are governed by ASHRAE standard 170 or similar standards that require minimum supply air flow rates during occupied mode operation by space type. In order to maintain thermal comfort this minimum air flow rate may be exceeded so for perimeter spaces the design air flow may be twice the minimum air flow. During unoccupied mode operation the minimum air flow can vary based on space type to either be zero, the box minimum, or the minimum required to maintain air flow direction between spaces. Although there is a way to schedule minimum airflows in EnergyPlus, this schedule applies to the calculated peak airflow in the zone. The user is unable to model the appropriate minimum airflow turndowns. This also impacts heating coil sizing. Adding a Min Flow Sch that applies not to the calculated peak, but the design minimum airflow will allow users to better model actual building operation.	AEI	NREL[1]
Dual unit reporting in Html	OpenStudio would benefit from having dual unit output in EnergyPlus. Is it possible to have E+ write html files in both SI and IP units and have the SQL file output in SI units? One option is to allow the user to specify separate units for the html and SQL reports. Another option is to always write the html in SI and in IP.	NREL	NREL[1]
Multiple Window Shading Devices	Allow multiple WindowMaterial:* objects to be used for a window. This will allow EnergyPlus to model a window with, e.g., both insect screens and interior shades, or different summer/winter shading multipliers.	NREL	NREL[1]
Add model options to WeatherProperty:SkyTemperature	As an outcome of ASHRAE Std 140 comparisons with other software, it has been suggested that the Martin-Berdahl (1984) sky temperature algorithm may be a better model than the current one in EnergyPlus, Clark-Allen (1978). LBNL reviewed literature on recent development of sky models and recommended to implement the calibrated (Li et al. 2017) Brunt (1932) and Idso (1981) models, which have higher accuracy compared to Clark-Allen and other existing popular models.	LBNL, GARD	LBNL[1]
No way to just convert IDF to JSON without running simulation	I would like to use energyplus -c my.idf to convert an IDF to JSON. However, when I do this, EnergyPlus also attempts to run a simulation. This takes additional time and generates many unwanted files. Can we add a way to only do the conversion and then exit?	NREL	ORNL[3]
Editor for epJSON	To foster greater support for the epJSON file format, develop an editor that can read and write that format and supports all objects that EnergyPlus supports. The editor would have capabilities similar to IDF Editor and would be a high-density display of inputs in a spreadsheet-like format. The fields would allow pull down lists for choices, links for names that are referenced, range checking for numbers, jumping to related objects, and provide helpful information. It would be driven the Energy+.schema.epJSON file. It would support multiple "extensible" objects like JSON supports. The editor would be able to display files in Inch-Pound or SI units and save in SI. Most of the features described are not present in general JSON editors since they are related to specific aspects of the EnergyPlus file format. The editor would be developed as a Python program using wxPython.	GARD	ORNL[2]

Ability to model non-convex zones and curved surfaces	Curved surfaces and non-convex zones are very common in building modeling. Easy way to model these directly instead of workarounds would be of great value to our customers.	Trane	ORNL[1]

Notes:

(1) Item is either under development, or completed
(2) Item to be evaluated for implementation in second half of FY20
(3) Item was addressed via a defect fix

Medium Priority Feature Requests

Title	Description	Requester	Assigned Lab
Shading control enhancements to support 90.1 on COMcheck	This feature is required to model an ASHRAE 90.1 Appendix C requirement (Section C3.5.5.1) which requires manually operated shades to be modeled for all vertical fenestration. Appendix C is the basis of COMcheck which is used widely for showing compliance with 90.1. These shades are required to be modeled to be lowered based on either a transmitted luminance threshold or a transmitted direct solar radiation threshold. Both of these thresholds are not supported by E+ currently. Also, 90.1 requires that once the shade is lowered that they remain in place until the end of the day. An option for that, and an option to set a minimum time between changes in shade status would also be useful.	GARD	LBNL[3]
Add Thermostatic Control of Ventilated Slabs	The current EnergyPlus model for ventilated slab systems is based on several assumptions that limit some of its capabilities. In particular, the current model requires that the users provide a schedule for the air inlet temperature flowing inside the slab. This specification does not allow EnergyPlus to control directly the indoor space temperature but only indirectly through adjustments of the airflow rate and temperature schedules. This process can be time consuming especially considering the time lag associated with the slab thermal mass.	University of Colorado	NREL
Add capability to model Ice and Snow Melting on Building Exteriors	Some high-end buildings use pipes embedded in sidewalks and parking lots to provide a safer, ice-free area around a building. While EnergyPlus has much of the weather information needed to potentially model these systems, EnergyPlus is currently not capable to estimate the energy consumption of snow/ice melting systems.	University of Colorado	NREL
Model a chiller with multiple compressors	EnergyPlus cannot model a chiller with multiple compressors, because the chiller reference capacity has the linear relationship with chiller power. The engineering output shows the equation as: Pchiller = QrefChillerCapFTemp/COPrefChillerEIRFPLRChillerEIRFTempChillerCycylingRatio. Actually, it is very often to see the chillers with multiple compressors in the real building. Unluckily, there is no good alternative way to model it right now. As every modeler knows, the chiller consumption occupied a huge energy ratio in a building, which means the importance of modeling a chiller accurately.	University of Colorado	NREL
Add model for thermal bridges	EnergyPlus provides no method to describe thermal bridges in envelope components. Develop adjustments to the conduction calculations for linear and point thermal bridges, similar to Psi factors. The need to accurately model thermal bridging is increasing with building energy codes and standards such as ASHRAE 90.1 working on addenda to include their impact.	GARD	NREL[1, 2]
Airflow Network Zone-Induced Air by Constant Volume Fan	Add a model for zone-induced (supply) air flow by a constant volume fan. This will allow EnergyPlus to model Case MA204 of the IEA Multi-zone air flow test suite.	NREL	

Allow users to directly autosize calculations	With other API work going on, users are going to want to call into EnergyPlus to do calculations. One of the most complex parts of EnergyPlus is the autosizing. But doing sizing is one of the strengths of EnergyPlus, and users have requested to access this functionality directly. Right now, users have to run a simulation to get sizing results. While I understand that some situations will require that, there are calculations that can be abstracted out to begin giving users a callable autosizing library. Specific parts of the autosizing world could be included in this and unified across component models as a part of the work.	NREL	NREL[1]
Non-Finite Difference Method for Temperature Dependent Properties	Allow materials with temperature-dependent thermal conductivities to be used with Conduction Transfer Functions, rather than requiring the finite difference model. This would allow handling such materials without a substantial impact on runtime. Existing Fortran implementation can be found. Accounting for variable thermal conductivity of insulation materials is required for energy code compliance calculations in California.	NREL	NREL
Enhanced Schedule:File operation	Currently, Schedule:File requires 8760 or 8784 files which is an entire year's worth of data. This requires filling schedules with junk values if running partial year simulations. I also do not know how this interacts with multiple year simulations. In addition, the schedule:file:shading object is an almost exact duplicate of schedule:file and they should be unified.	NREL	NREL

Notes:

(1) Item is either under development, or completed
(2) Item is being split in two phases: evaluation and full specification in FY20; code implementation in FY21
(3) Under consideration for FY20 fall release, or postponed to FY21

Low Priority Feature Requests

The following items will not be considered at this time:

Title	Description	Requester	Assigned Lab
Forced to natural convection transition for "Ceiling Diffuser" convection model	EnergyPlus v9.1 fixed a defect in the "Ceiling Diffuser" convection model. The intended operation of this model was to represent forced convection for air circulation rates of more than 3 ACH, and to resent natural convection for air circulation rates less than 3 ACH. Previously, the model was using forced convection for all air circulation levels, but apparently this was not intended. There are two issues with this return to "intended" operation of the model. First, the 3 ACH threshold needs to be validated. Second, the change from forced to natural convection is currently a step change rather than a smooth transition. It is unclear whether this represents actual building physics. Validation: The basis for the 3 ACH threshold is not clear. Talking with EnergyPlus developers, a source for the 3 ACH threshold could not be cited. A large fraction of VAV air systems have VAV box minimum flow rates less than 3 ACH so heating season and heating design operation is affected by the 3 ACH threshold. Heating loads and therefore heating energy consumption is significantly lower when assuming natural convection rather than forced convection in these zones. Having a strong, documented basis for the 3 ACH threshold is therefore very important for the accuracy of EnergyPlus and the credibility of the engine as EnergyPlus gains wider use among engineers doing "production" work - that is creating equipment specifications for commercial projects and doing energy modeling to optimize these system designs. Transition: The second aspect of this is whether the change from forced to natural convection is actually a step change that occurs at a particular ACH threshold, or is a smooth transition that occurs across an interval between two ACH levels. Having a strong, documented basis for the transition modeling is also important for accuracy and credibility of EnergyPlus results. It is possible initial FlexLAB test results can help with validation of the model. However, talking with the researchers, it appears much more test work is needed to fully validate the threshold and to understand how transition between convection modes occurs.	Carrier	
Sky radiant cooling systems	Sky radiative cooling systems such as RadiCool and SkyCool use materials with selective spectral properties on heat exchangers on roof to produce cool water. The new materials can radiate heat to deep sky even under the sun. This new feature request will enable EnergyPlus to model this type of materials with selective spectral properties of emissivity and absorptance.	LBNL	LBNL

Dedicated Heat Recovery Chiller Objects	Heat recovery chillers are gaining greater prominence in high performance design so having separate heat recovery chiller objects with dedicated controls for heating/cooling dispatch is necessary.This is especially important when working on utility scale projects as this measure is a significant energy saver. Having built-in controls will also help stanardize energy models as this is currently done using custom EMS programs. Requring a condenser loop to model these chillers significantly impacts modeling accuracy.	AEI	LBNL
VAV Chilled Beams	EnergyPlus supports constant volume chilled beams, but not variable volume beams. Various workaround exist, most are incapable of accurately modeling resulting performance curves, therefore native support for variable primary flow to chilled beams would help model modern designs more accurately.	AEI	NREL
Support modeling of GEB (Grid interactive efficient buildings) technology: Switchable Insulation Systems	Currently EnergyPlus cannot be directly used to model several GEB technologies including switchable insulation systems for walls and roofs. Indeed, EnergyPlus assumes that CTFs for walls and roofs are static and do not change with time depending on a set of controls and sensors. This new feature request will enable EnergyPlus to support the modeling of GEB related technologies and strategies.	University of Colorado	NREL, LBNL, ORNL[1]
Add Options to Control Low Temperature Radiant Systems Based on Thermal Comfort Models	The current EnergyPlus models for radiant systems (radiant floors and walls) allow only the indoor temperatures to be maintained as no control strategies are available to operate the systems based on other thermal comfort indicators such as PMV levels or main radiant temperatures. However, forced air systems (such as packaged single zone or variable air volume) can be modeled in EnergyPlus using control strategies involving different thermal comfort indicators. Thus, it is difficult if not possible to compare the performance of radiant floors to forced air systems when both are controlled using thermal comfort indicators other than air temperatures. A wide range of studies including those conducted by the project team members have shown that significant energy savings can be achieved by operating radiant slabs using other indicators more representative of indoor thermal comfort than air temperatures.	University of Colorado	NREL
Phase II of cross-platform EP-Launch	Phase II: The first phase of a cross platform EP-Launch3 development has been completed. EP-Launch3 replaces MacOS EP-Launch Lite and eventually will replace the Windows EP-Launch2. Many of the goals of the software were completed in the first phase but remaining issues include the ability to run multiple files at once, polishing the user interface, ability to abort processes including simulations, check the version of files being simulated, indicate when files are stale, improving unit testing and continuous integration, and enhancing the installer (see the complete list on the issues page for the project). The original plan will be reviewed and the software will be audited to ensure all desired features have been implemented. In addition, actual users will be encouraged to use and provide feedback.	GARD	NREL

Improving output metrics for time sensitive valuation of energy efficiency in EnergyPlus	For example, including breakouts of energy use (and CO2 and cost, if possible) by peak, mid-peak, and off-peak periods; peak/off-peak cost delineations would require the application of time-of-use electricity rates or something similar to simulatied energy use totals. Note that in a recent survey we conducted about time-sensitive valuation of energy efficiency capabilities in DOE tools, one user commented that these breakouts are already available in EnergyPlus, but I didn't think they were.	LBNL	LBNL
Occupant-centric metrics	Occupant-centric metrics are needed to evaluate resilience and demand flexibility of buildings. We propose to add occupant reports on thermal comfort (e.g., heat index, discomfort degree hours), visual comfort (e.g., DGI), and IAQ (e.g., CO2) at the whole building level as well as space level.	LBNL	LBNL
Allow Daylighting:Controls to reference Daylighting:ReferencePoint in other zone as well as exterior sensor	Many real world cases control lights in one zone based on sensor in another zone. I believe there is currently a restriction that does not allow this in E+ (however the input data model does allow for this). It would also be useful to use global horizontal illumination as the reference for Daylighting:Controls, this would allow open loop control based on exterior sensors.	NREL	NREL
Support BTO GEB (Demand flexibility, TSV, MELs)	BTO has a new initiative GEB which will improve interactions between buildings and their serving electric grid, considering the dynamics and flexibility of energy supply, demand as well as storage. Sensing and controls are critical to enable GEB at the individual and group of buildings. This new feature request will enable EnergyPlus to support the modeling of GEB related technologies and strategies. I particular, these can be considered: (1) adding cateroies of MELs as input and reporting breakdown, in consistent with MELs end use representation in Scout (https://scout-bto.readthedocs.io/en/latest/); (2) enabling flexible loads input by a time window and percent loads; (3) modeling electric vehicle charging.	LBNL	NREL, LBNL, ORNL[1]
Make .idf to .epjson Translator a Standalone Utility	Many programmatic workflows currently use an idf as the model input file. Before these users switch to using .epjson for modeling inputs, they need a reliable means to test their input files. Currently, EnergyPlus handles this translates internally at runtime. It would be very beneficial for these EnergyPlus users to have direct access to a python utility that does this translation programmatically. This would enable automation workflows to gradually make the transition to .epjson. A similar utility to programmatically upgrade EnergyPlus input files to later versions would also be greatly appreciated.	AEI	

Notes:

(1) Item may be considered under a separately funded multi-lab work

Other Requests

Title	Description	Requester	Notes
Single Hydronic Coil Object	Complex system configurations and energy recovery loops require custom coil controllers. It would work well for end-users if a single hydronic coil component was available for both Heating and Cooling like the fan system model that allows multiple types of fans to be modeled.	AEI	May be addressed as part of model refactoring scope
Regression results between engine release	This is not a feature proposal but an easy way to look up difference in results for available test suites between two releases. We like performance metrics would also like to include result comparison for available test files.	Trane	To be addressed as part of the CI and Automated Testing framework for EnergyPlus