

Energy Programs by USDOE - DOE21E and EnergyPlus

The results of energy programs are not used in design and therefore not used in construction an operation. Energy program results are used to compare alternative design options and make decisions when selecting envelope, systems and plant. They are also used to show energy code compliance and for sustainable buildings certification.

Design decisions are also based on

- first & maintenance costs,
- reliability & durability of systems, plant and equipment,
- ease of operation and maintenance,
- availability of parts & maintenance staff at the location
- environmental impacts

DOE21E

DOE21E has been neglected for 15 years and USDOE is now spending its resources to make sure it is dead hoping this will force the building community to use EnergyPlus.

DOE21E is still good for over 90% of building projects. See letter from Joe Huang to LBNL where I indicate that an unrestricted, free, open source version the program will be a valuable resource to graduate research students if the program is developed so that users can add (attach, integrate) independent programs and code to DOE21E.

<http://www.whiteboxtechnologies.com/> Click [here](#) for the **Open Letter to Lawrence Berkeley National Lab (LBNL) on Open Source DOE-2.1E.**

See also http://bepan.info/articles_3_-_VCT_-_Building-Design_and_Energy-Analysis-Programs

Here is a summary of how to fix DOE21E so that it can be used for research:

1. Expand the feature of inserting user created programming statements, functions and subroutines into the BDL so that engineers perform specialized tasks required by projects and insert them into the input BDL. Provide detailed documentation of how to do this with examples
2. The intermediate results between Loads, Systems, Plants & Economics modules are saved in intermediate temporary files for use by the next module. Hourly results of all the FORTRAN variables from each module are available for print out by the program. The BDL input data is read into FORTRAN variables and so also are the output report variables. All this data should be organized, formatted and saved in Excel type files that can read by other programs.

3. Freeze the existing code since it is error-free and make it possible for research students to add/attach independent sub programs to expand the features of DOE21E. The independent (or dependent) sub-programs that can be interfaced with DOE21E should include PV-modules, GSHP, UFAD, DOAS, Radiant-ceilings and other features not included in DOE21E. There could be multiple versions of each sub-program by different authors. A DOE21E committee should establish common output reports for them.

My message to AE firms asking for support (on behalf of Joe Huang) admits that DOE21E cannot be used on projects as it stands now. A-E firms have switched to other programs but not EnergyPlus. But they can expect a lot of advanced program development using an open source DOE21E as the base launching pad from enterprising architects, engineers, academics in the areas renewable energy and also in testing new concepts.

The analogy is countries like socialist India and communist Russia & China opening up development to individual free enterprise. All the economies are now booming after 15 years. Their economies stagnated during the previous 50 years of the government doing everything.

Trane & Carrier have their own energy programs based on their equipment and systems. Other manufacturers can now create energy programs starting with the open source DOE21E and base it on their own equipment. These would be program developers that are involved with real buildings from design through construction and operation and understand the business. Equipment consumes energy in buildings, not the envelope or people. Manufacturers would therefore have vested interest in making sure that their energy programs produced results that are close to the building in operation.

DOE21E was developed with tax dollars for over 15 years. It became the energy standard throughout the world for codes and standards. EnergyPlus (released in 2003 but development started in 1996) has also gone through a 15 year development with tax dollars.

There are programs based on DOE21E that were developed with tax dollars such as COMCHECK by PNL, Building Design Advisor (BDA) by LBNL, Energy-10 by NREL, and EE4 by the Canadian government. I hope USDOE is not planning on wasting more tax dollars by redeveloping these programs using EnergyPlus.

http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/eng/software_tools/ee4.html	EE4
http://energycode.pnl.gov/COMcheckPkgGen/	COMCHECK
http://gaia.lbl.gov/BDA/	BDA
http://www.nrel.gov/buildings/energy10.html	Energy-10

Private firms have developed interfaces to DOE21E (VisualDOE, EnergyPro, EZ-DOE, etc.) and programs that use DOE21E as analysis/computational engine (Building Energy Analyzer). USDOE should compensate these private firms. Also, projects at A-E firms that used DOE21E cannot be reviewed if a question or problem arises. If this situation arises they should get compensation or have USDOE convert the files for use with TRACE or HAP

<http://www.energysoft.com/> (EnergyPro)

<http://www.elitesoft.com/> (EZ-DOE)

<http://www.archenergy.com/products/visualdoe/> (VisualDOE)

Instead of throwing DOE21E away, USDOE should give it back to those who paid for it. Joe Huang should also consider making EE4, COMCHECK, BDA, Energy-10 (used tax dollars) unrestricted open source programs.

Few A-E design firms use EnergyPlus. If they do, they are wasting their client's money. Some clients might be impressed with the extra mathematics used by EnergyPlus and that it therefore takes much longer to execute. Most Users of programs based on DOE21E in the USA have switched to eQUEST, TRACE and HAP and not EnergyPlus. All 3 programs are in use at a single A-E firm depending on the project. Statistical data of the programs used by the industry must be available today because energy code compliance and LEED certification.

Why is USDOE developing computer programs with tax dollars and competing with the private industry? It discourages and prevents private entrepreneurial development of energy programs. USDOD and other government departments sub-contract this type of work to the private sector. EnergyPlus should also be released to the public as an unrestricted open source program and let the private sector develop it. USDOE should stop developing energy programs.

EnergyPlus

EnergyPlus is a replacement for DOE21E because it is based on the metric system and would be a success if it got rid of the unnecessary features that increase execution time.

There is no such thing as an accurate energy analysis program. Relative accuracy when comparing building components, loads, systems, equipment, plant of Energy Savings Option (ECO) is required and important. EnergyPlus does not produce better, superior or more accurate results compared to other energy programs when the results are compared to the completed building in operation.

In the case of large commercial buildings, the actual energy consumption by the completed building is almost always higher than the energy use predicted by all energy programs. A-E design firms sell their services to clients showing the energy efficiency of their building design.

EnergyPlus, with its extreme theoretical accuracy, probably shows the lowest energy consumption. The A-E design team has to explain to the building owner why the actual building energy use is much higher than their design estimate after the building is in operation. This can be interpreted as deceiving the client to get to design the project.

The heat balance method in EnergyPlus has to be replaced in the Loads section with the transfer function method. The HB accuracy is not required for walls since they make up an

insignificant amount of the energy used in commercial buildings. In my opinion the TETD method is also good enough

It is ridiculous to model Systems & Plant with a single combined network of ductwork and piping sections using node numbers, branches, fittings, etc. in an Energy program. Design Piping and Ductwork design programs are offered separately and there is no simultaneous design because in practice it is done separately. Even now most engineers prefer to design ductwork and piping systems manually with “ductulators” and “pipulators”, or sizing charts.

The performance of ductwork, piping, coils, terminals, and other equipment in ductwork & piping systems decline with age. Scale builds up in piping and coils, filters and other equipment have to be cleaned frequently to maintain design conditions. The systems nodal network analysis in Energy Plus does not make the program more accurate.

Why would anyone want to analyze a building using 6-minute intervals (I am told that the options include 1 minute intervals)? The weather, schedules and profiles are in hourly intervals and they are very approximate. Occupancy schedules are based on guesstimates. Two identical office buildings next to each other will not have the same occupancy in any given minute.

All this accuracy is to maintain every individual in a building and space perfectly and exactly comfortable at all times. The occupants in a space would include a mix of different ages, health conditions, ethnic backgrounds (from hot & cold countries), moods (calm & angry), etc. Until 100 years there was no air-conditioning and fireplaces were used for heating in cold countries. Humans survived. After all this extreme program accuracy the results of EnergyPlus can be completely off (usually too low) from the measured performance of the building in operation.

EnergyPlus was advertised as the best of DOE21E and BLAST. Anyone who has used DOE21E can see that the basis of EnergyPlus is only BLAST. It is obvious that the designers and developers of EnergyPlus had never used DOE21E. I don't think the DOE21E developers at LBNL were involved this program. LBNL could have done a better job based on their 15 years of experience with DOE21E and feedback from users.