A tool for making psychrometric calculations in HVAC systems.

When it comes to making calculations of possible savings by altering temperature and humidity setpoints there are not very many tools to choose from… if any! If you at the same time have to deal with changing airflow, different weather profiles, room loads, etc. the traditional ways of calculating are simply not suitable. Since I had a lot of projects where these calculations were necessary, well, I had to develop my own tool! It took a lot of work to get where I am now, even though I could draw on 20+ years of experience working with energy, programming and tools. Until now I have analyzed savings in some 190 HVAC-cases, using many combinations of the following features of my tool:

- Fetching and aggregating climatic data: Aligning and repairing data to fit with 8760 hours pr year. Raw data from airports are collected via the internet, and they often exhibit faults and missing data that has to be repaired.
- Calculating the total annual energy consumption needed to condition a given room to specific temperature and humidity limits. Climatic data for fresh air supply are used together with estimated room load (power and humidity load, both positive and negative), all data mapped for each 8760 hours of the year.
- Energy calculations divided into energy for heating, cooling, dehumidification, reheating and humidification.
- Water consumption and draining of condensed water calculated for cooling, dehumidification and humidification processes.
- Energy calculations that include factors of efficiency, offset and bias for all utilities: Heating-boiler, chillers and steam-boiler (includes bleed-off). All factors are variable for each 8760 hours of the year.
- Energy calculations with both fixed and variable recirculation (optimizing to utilize free cooling). This is only possible through the use of several iterations of all calculations.
- Heating calculation including heat recovering. This is also only possible through the use of several iterations of all calculations. Simple temperature efficiency is used, together with safety margin for freezing and start offset. Calculations including condensation and un-linearity will come later.
- Total annual energy, water and sewage costs calculations. Costs are all based on individual tariffs that can vary through out all 8760 hours of the year.
- Total annual CO_2 emission from energy, based on individual but fixed factors for the year.
- Calculation of dehumidification with desiccant type dryer, including unwanted power spill-over into the main air-stream.
- Peak power calculations for all energy users (and flow for water). Useful for dimensioning purposes.
- Reports with savings scenarios compared to baseline. 1 to 3 scenarios are compared.
- Visualizing the effect of each step in the conditioning process, using Mollier-diagrams.
- Visualizing the savings using diagrams with values sorted by decreasing magnitude.
- Easy mapping of varying parameters through out the year, using a special calendar editing tool for pasting re-occurring values, e.g.: Decreasing temperature set point during night and weekends.
- Analysis of the effect from changing selected input parameters can be made for 10 or 10*10 scenarios. Results are displayed in diagrams and tables.

- Cooling calculations utilizing variable coil temperatures are used to compensate the chillers COP in iterative calculations.
- Energy calculations for systems with make-up- or preconditioning-units are possible through the use of interim "weather" data system.

Here are some data about the program, just to show you how much is needed:
- 35 energy-dedicated Visual Basic functions
- 55 MS Excel worksheets and diagrams
- 35 routines handling functions and worksheets
- >3000 lines of code
- 50 input parameters (438,000 input parameters pr year if full one-hour flexibility is utilized)
- 35 output parameters (~results) for every 8760 hour of the year (+40 interim parameters)
- 30 global input parameters or constants
- 2 to 100 iterations in several loops depending on application
- 75 function calculations pr iteration for every 8760 hours of the year
- 1.5 to 70 million formula-calculations pr run
- Double precision data to minimize rounding errors

I run it on an isolated virtual XP-Pro machine (Parallels) on a MBP, and the typical execution time is 0:50 min.

Savings related to air handling is calculated in another tool (see "Air Handling Tool"), although I have linked them together for obvious reasons.

The tool is not for sale, unfortunately. The user interface in not suited for the average user, and it would take a huge effort to improve it up to the level where it can be "left alone" with an HVAC engineer ☺