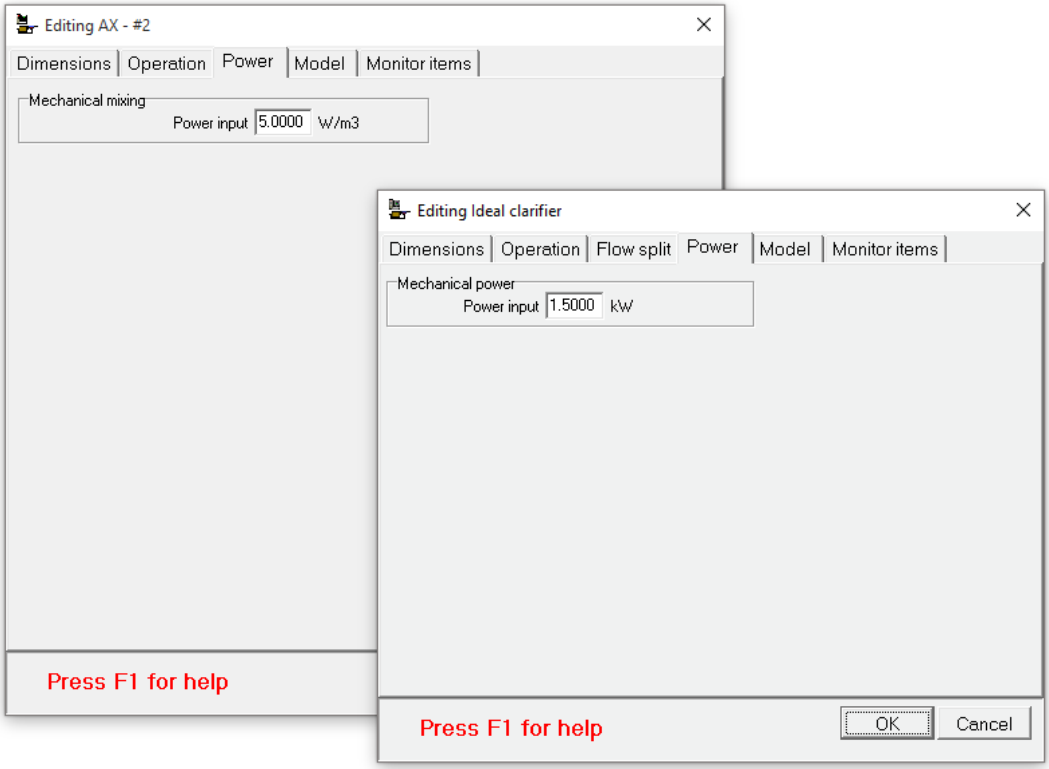
New Developments in BioWin 5.2

February 16, 2017

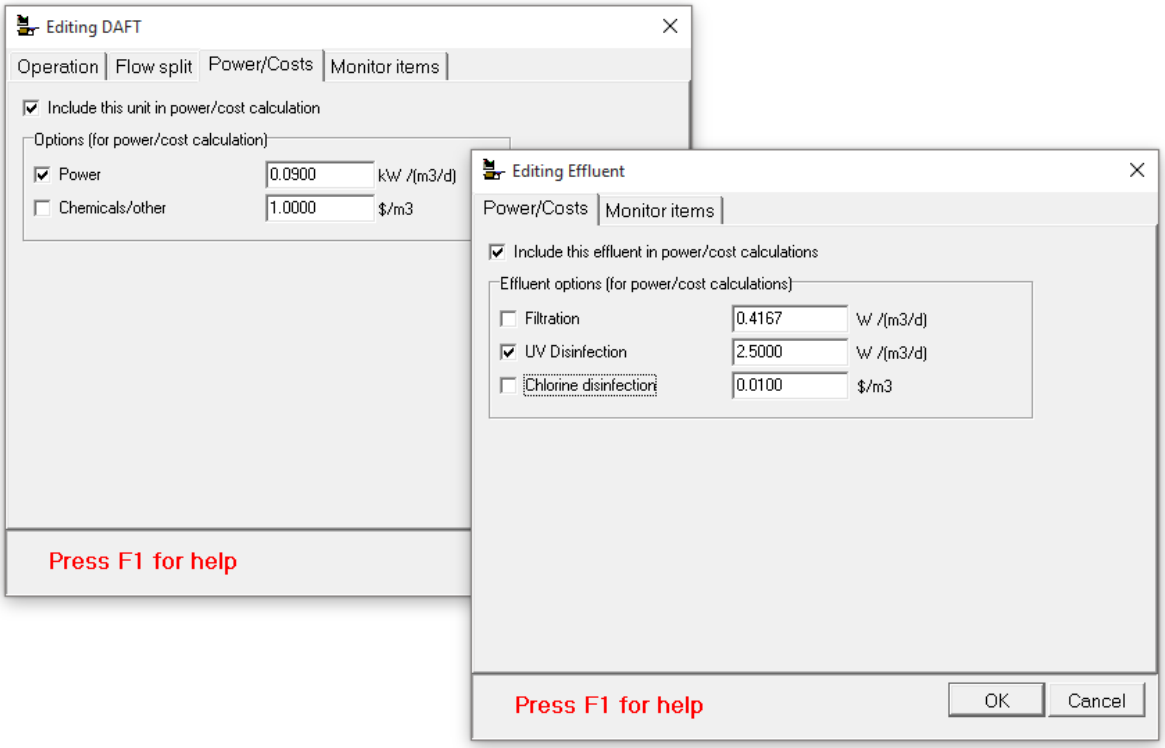
BioWin 5.2 contains many exciting new updates that build upon the energy and operating cost features first introduced in BioWin 5.0, further expanding its capability as a plant management tool, and for comparing design alternatives.

Power Requirements – New & Improved Tracking Functionality

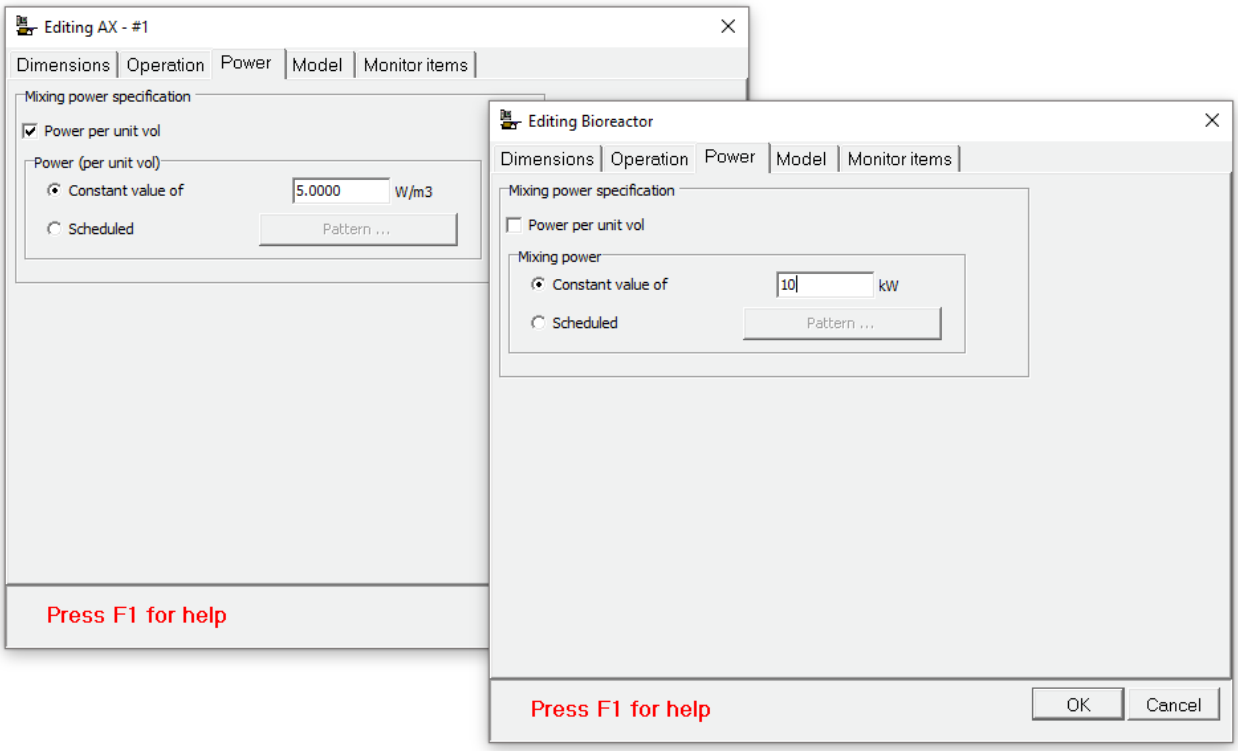
Power still is tracked for flowsheet elements *via* their Power tabs. ***However, in BioWin 5.2 there are many more options for tracking an element's power consumption***. Since BioWin 5.0, many elements track a constant power demand, *e.g.* the mixing power for a bioreactor or mechanical power for a secondary clarifier:

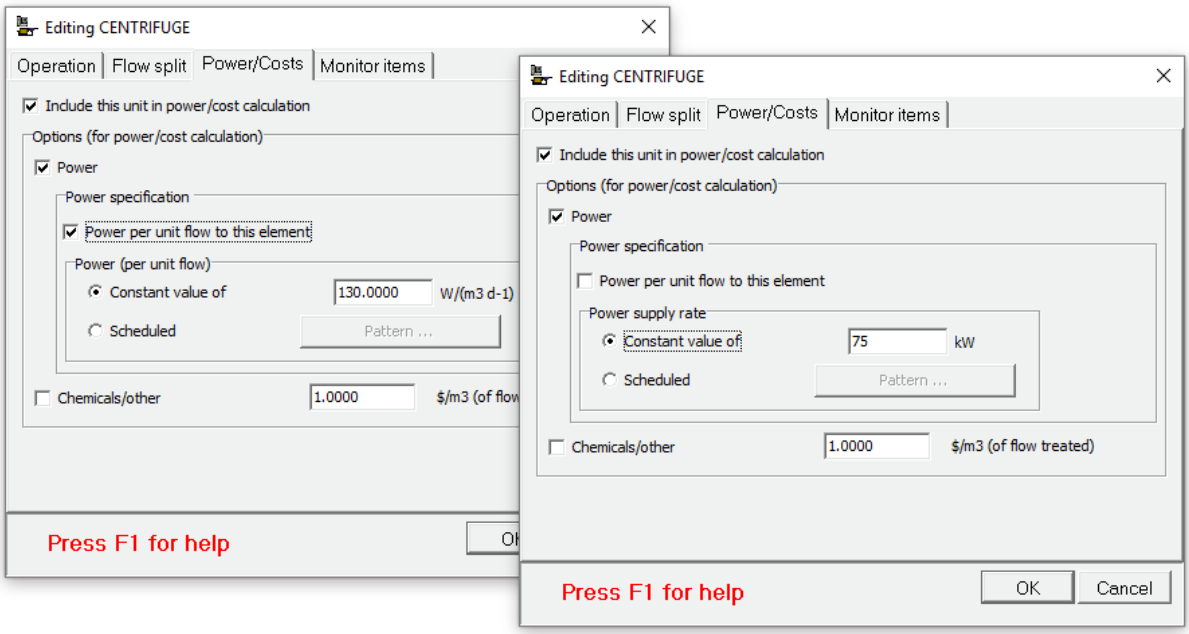


In other cases, the power depended on the flow going through the element, such as for a dewatering unit or an effluent output:

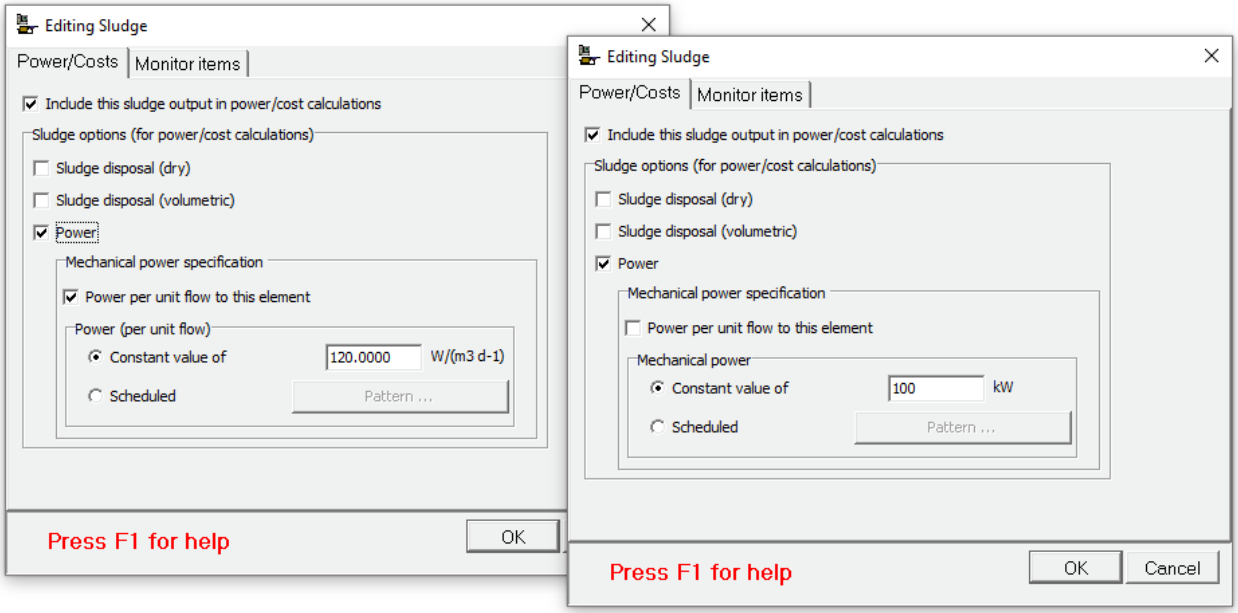


In BioWin 5.2, all elements can track power demand on either a unit volume/flow basis, or a direct user-input kW (or hp) basis. Each of these options can be constant, or vary with time as shown below:





Additionally, sludge output elements now have the ability to track power demand on either a unit flow basis, or a direct user-input kW basis (***neither option was available for sludge output elements in BioWin 5.0***). This allows for tracking of energy requirements for certain sludge disposal technologies.



Power Requirements – New & Improved Output Functionality

Two new outputs related to power requirements have been added to BioWin 5.2:

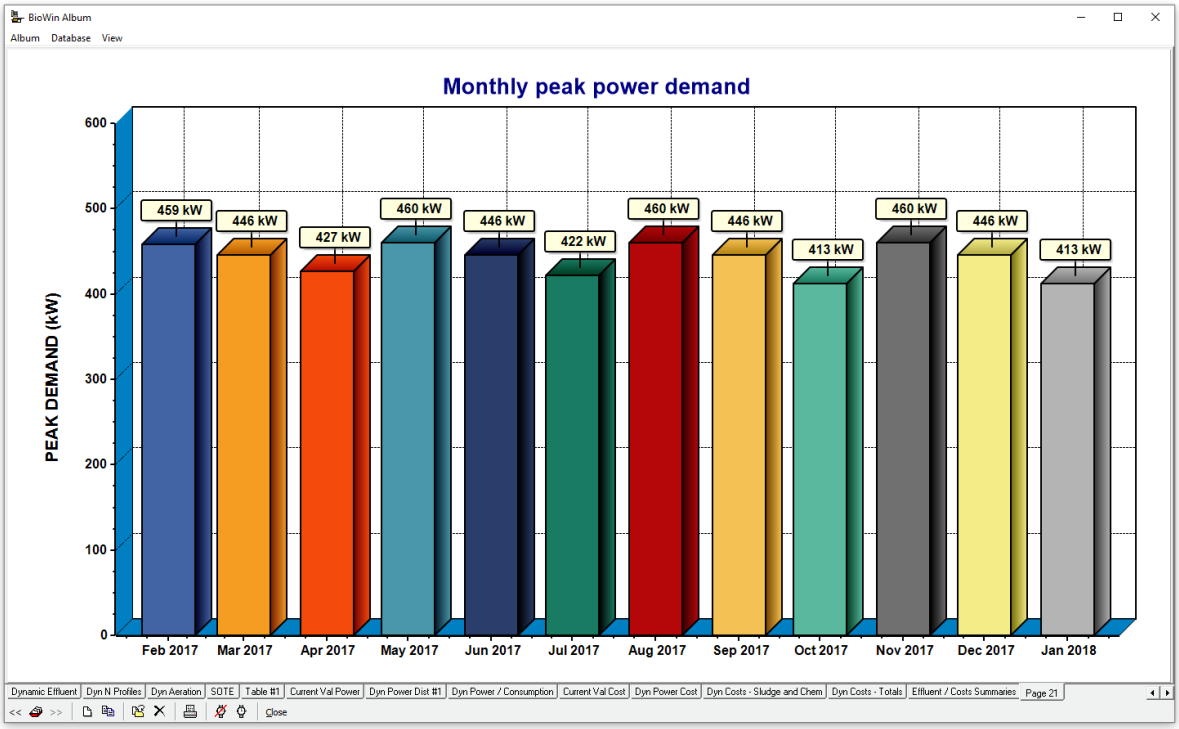
1. You can add pre-defined air supply group (*i.e.* blower) tables to the album. These tables show the breakdown of power requirements for different air supply groups that have been defined, along with various calculated values used in the blower power calculations (*e.g.* intake pressure, discharge pressure, intake airflow):

BioWin Album

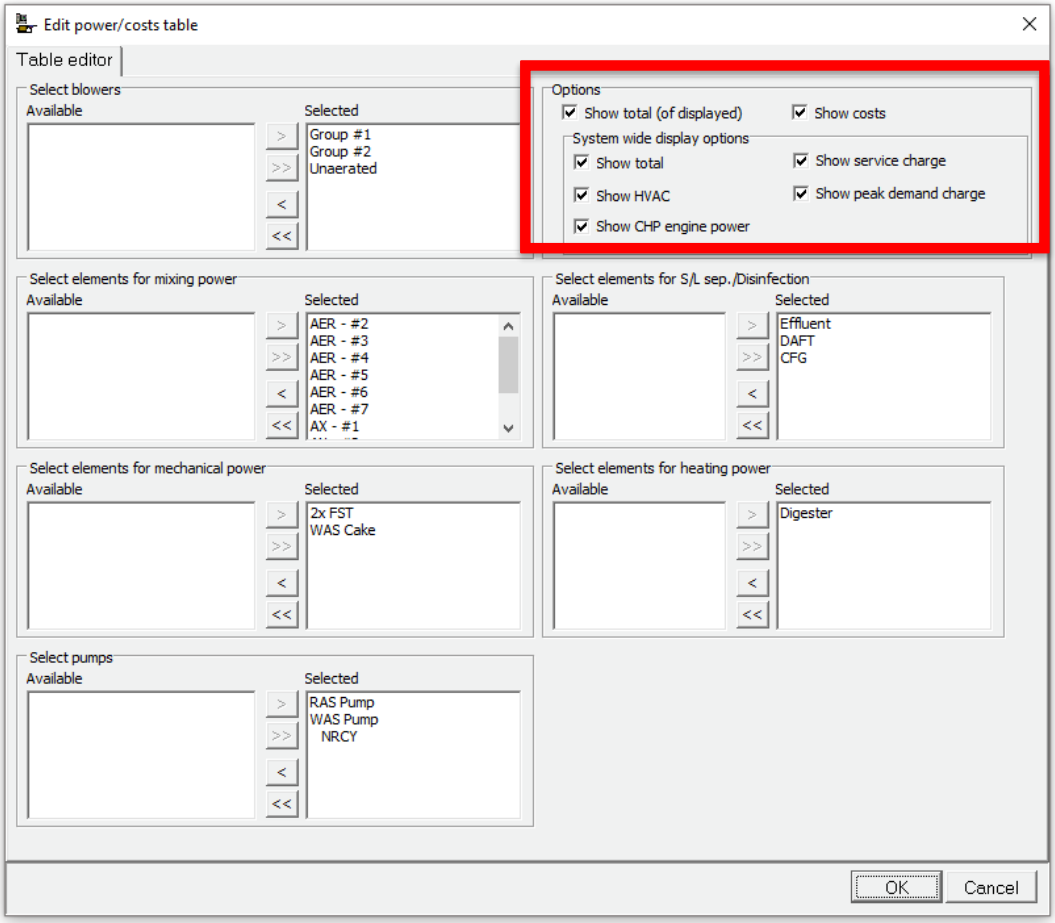
Album Database View

Air supply group	Power [kW]	Intake pressure [kPa]	Discharge pressure [kPa]	Intake airflow [Humid m3/hr (field)]
Group #1	146.30	97.83	148.98	9034.42
Group #2	64.52	97.83	148.98	3983.97
Unaerated	0	97.83	148.98	0
-----	-----	-----	-----	-----
Total	210.82	-----	-----	13018.38

2. You can add a chart that shows the peak 15-minute power demand for each month over the most recent 12 months of simulation; this facilitates calculating and checking demand charges for the subsequent month:



Furthermore, BioWin 5.2 pre-defined power tables and charts have been rationalized and expanded to improve clarity. When creating power tables and charts, you now have the option to include “system wide” parameters such as HVAC as separate line items:

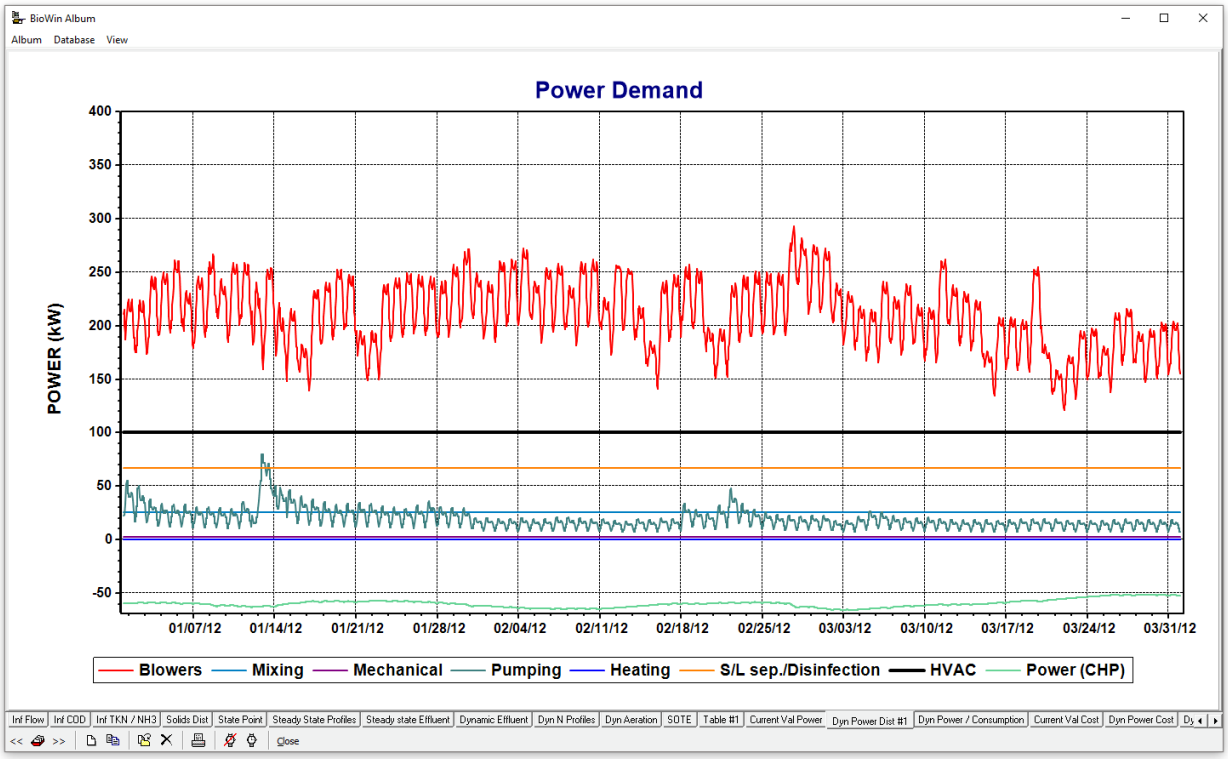


These options result in tables and charts that are informative yet easy to follow:

BioWin Album

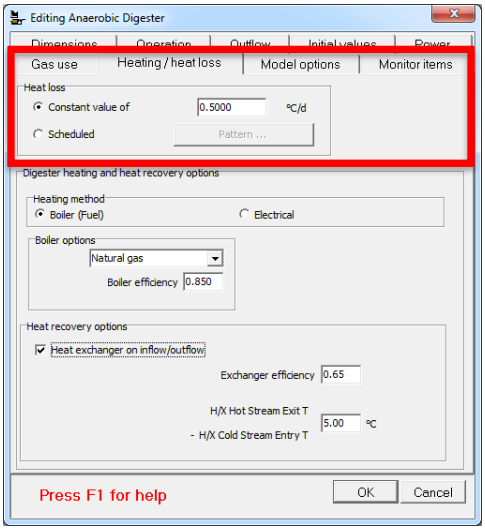
Album Database View

Power Categories	Power Demand [kW]	Cost (Power consumption) [$/hour]
Blowers	210.82	21.50
Mixing	26.00	2.65
Mechanical	3.00	0.31
Pumping	18.39	1.88
Heating	-----	-----
S/L sep./Disinfection	67.24	6.86
-----	-----	-----
Total of tabulated	325.45	33.19
-----	-----	-----
HVAC	150.00	15.30
Service Charge	-----	0.05
Peak Demand Charge	-----	5.47
-----	-----	-----
System total	475.45	54.01
Power (CHP)	-59.43	-----
-----	-----	-----
System net	416.02	47.95

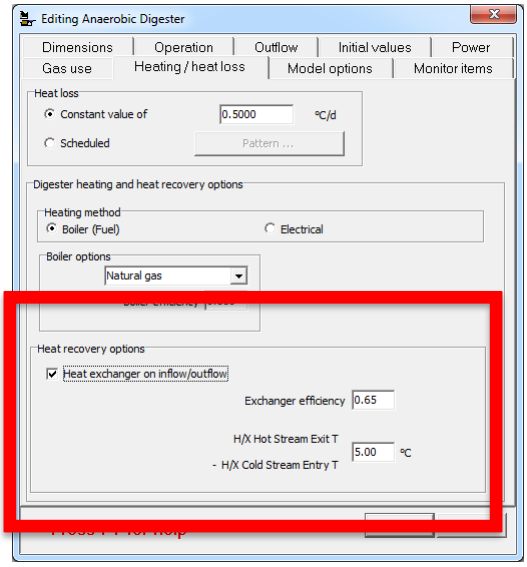


Heating Requirements – New & Improved Functionality

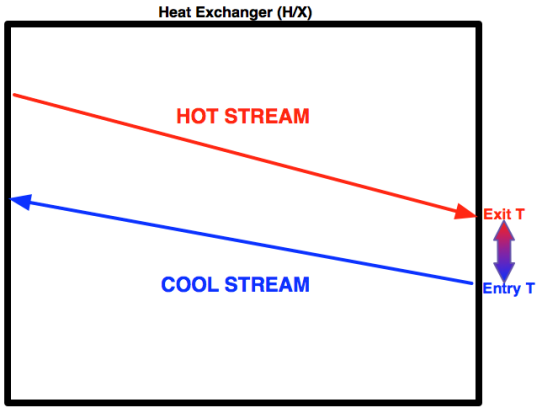
The heating power requirement is determined for Anaerobic Digester and Thermal Hydrolysis flowsheet elements. Typically, the main component of the heating power is the amount of energy required to heat an influent stream to the desired operating temperature specified in the Anaerobic Digester and/or Thermal Hydrolysis unit elements. Additional heating power may be required in an Anaerobic Digester element to overcome a specified digester heat loss. ***A new feature for BioWin 5.2 is that the anaerobic digester heat loss can vary with time, as shown below:***



The heating power requirement is provided from a fuel or electrical source [see later], but there are also options in BioWin for heating power recovery within the Anaerobic Digester and Thermal Hydrolysis Unit elements. ***The heat recovery option for anaerobic digesters is a new BioWin 5.2 feature***:



When the option to include a heat exchanger is specified, BioWin assumes that the hot digester (or THU) output stream is used to heat the cool incoming stream in a counter-current heat exchanger. Users can enter the efficiency of the exchanger as well as the temperature difference between the heat exchanger's hot exit stream and cold entry stream. A schematic representing the difference in temperature between the hot exit and cold entry streams for the heat exchanger is shown below.

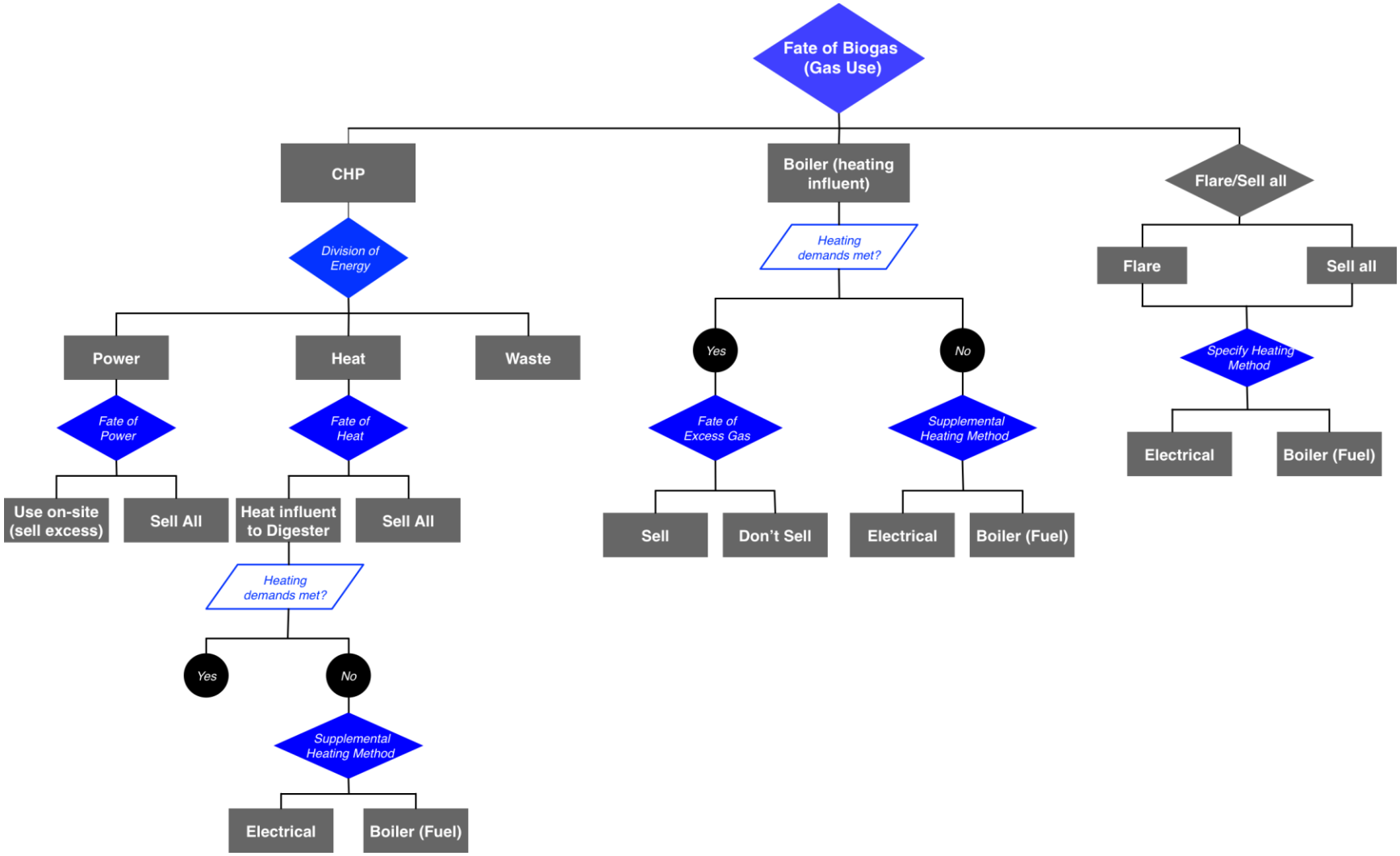


Another new BioWin 5.2 feature is that it is now possible to choose between two heating methods for anaerobic digesters and thermal hydrolysis units:

1. Electrical heating which will incur an electricity cost, or
2. Heating *via* an external fuel source used in a boiler (*i.e.* natural gas, heating oil, diesel, or a custom fuel) which will incur a cost for fuel.

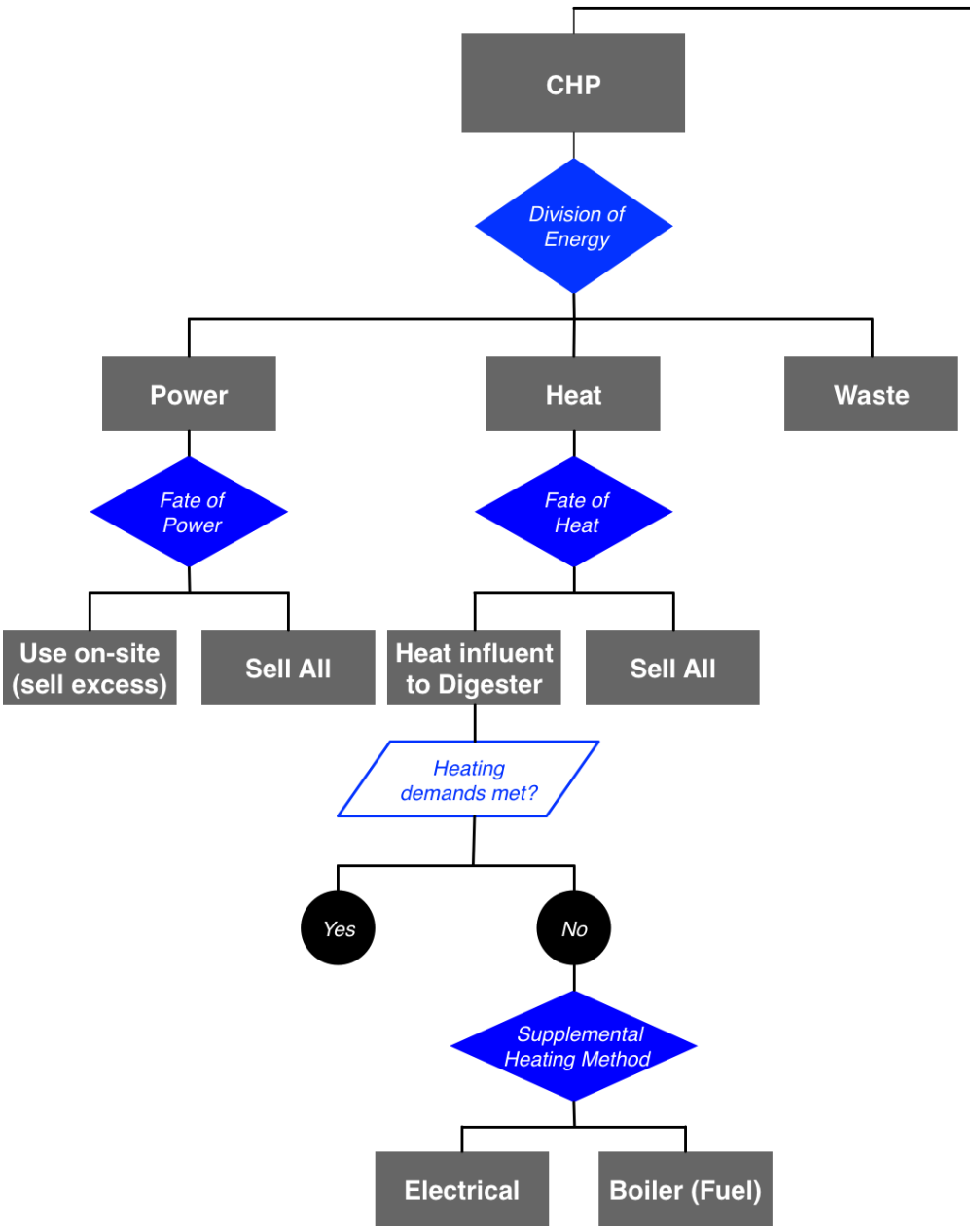
BioWin 5.2 also allows you to choose how biogas generated in an anaerobic digester is used. The overall multiple options for biogas use are shown in the following diagram (and options for additional heating needs are identified):

Potential Uses for Digester-Generated Biogas in BioWin 5.2

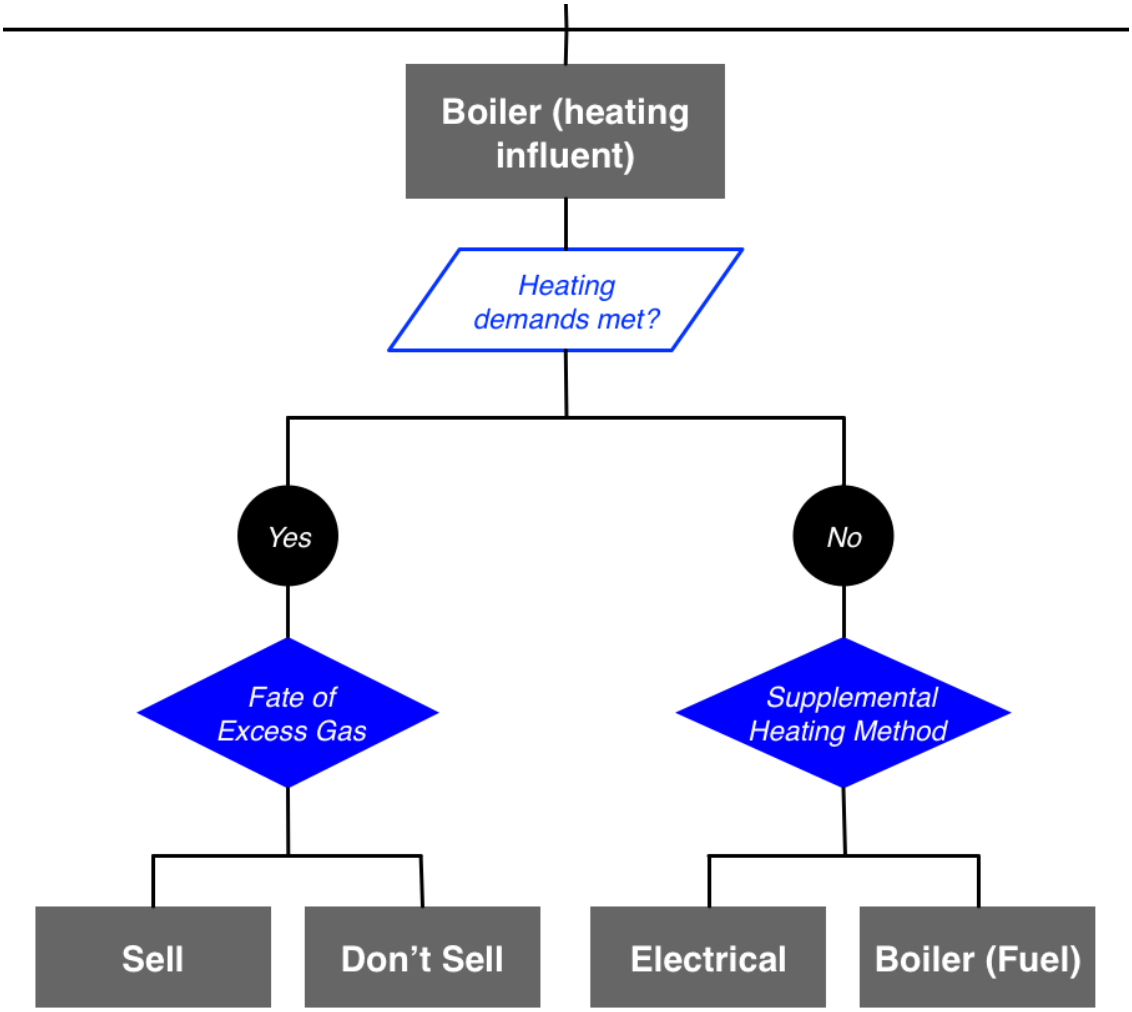


Digester biogas may be used in three main ways:

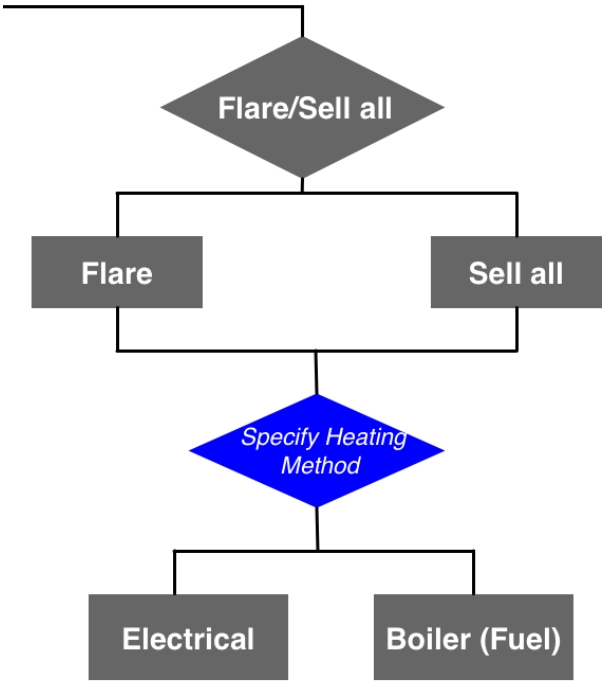
1. Using the biogas in a Combined Heat & Power (CHP) engine. This pathway includes options for selling all or left-over generated power; using or selling non-waste heat, and the method used for additional digester heating if required (*i.e.* electrical or use of external fuel).



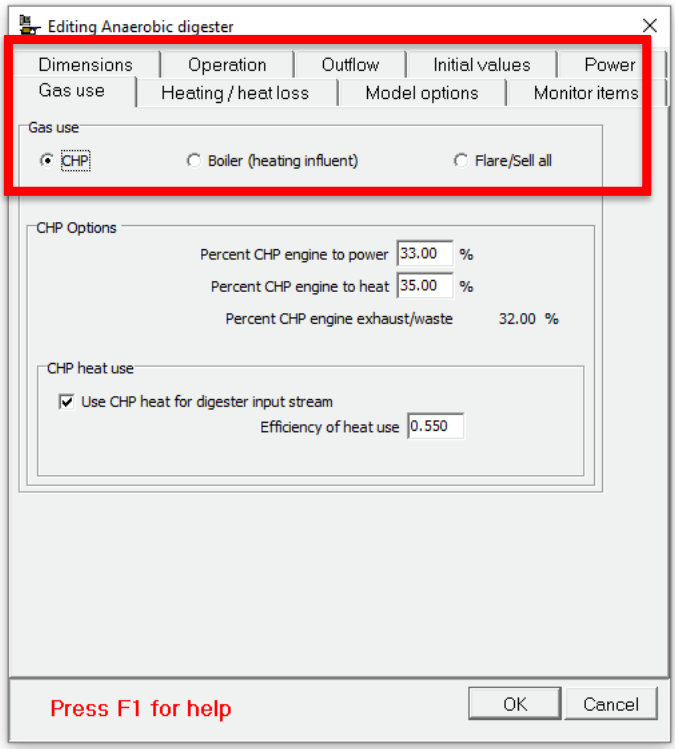
2. Burning the biogas in a boiler for heating and supplementing *via* electrical or external fuel sources if insufficient gas is available. If there is any excess biogas after satisfying heating demands, there is an option to sell it.



3. Either flaring off or selling all of the gas. For either option, the method used for digester heating (*i.e.* electrical or use of external fuel) must be specified.



The above pathways are selected using the new Anaerobic digester **Gas use** tab:



Costing Calculations – Selling Anaerobic Digester Biogas

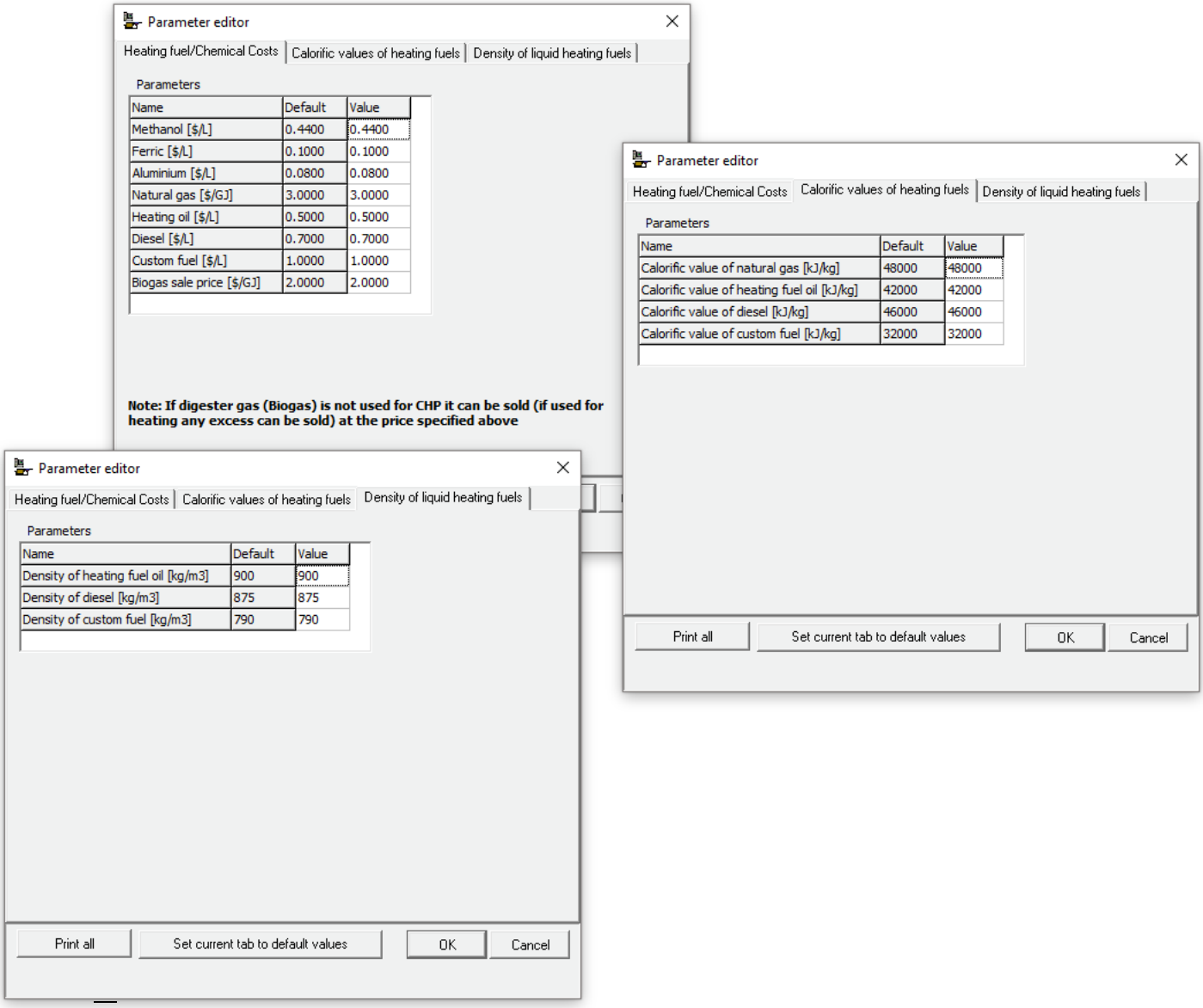
BioWin 5.2's ability to track fuel consumption that may be associated with anaerobic digester and/or thermal hydrolysis unit heating required the addition of a new cost tracking category. In addition to the three categories tracked by BioWin 5.0:

1. Costs associated with energy consumption.
2. Costs associated with consumption of chemicals / consumables.
3. Costs associated with sludge disposal.

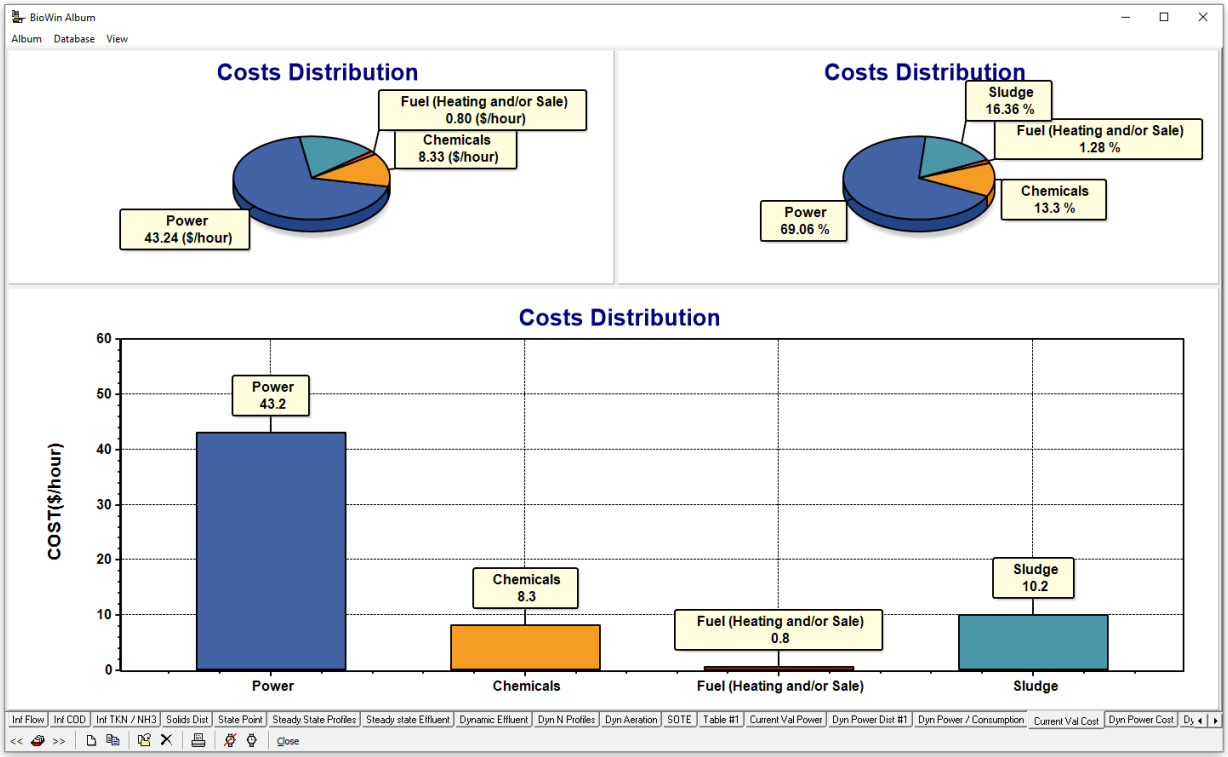
BioWin 5.2 adds a fourth category:

4. Costs associated with fuel consumption.

Cost, energy content, and liquid density for a variety of heating fuels may be specified *via* the **Project > Costs/Energy > Fuel/Chemical** menu:

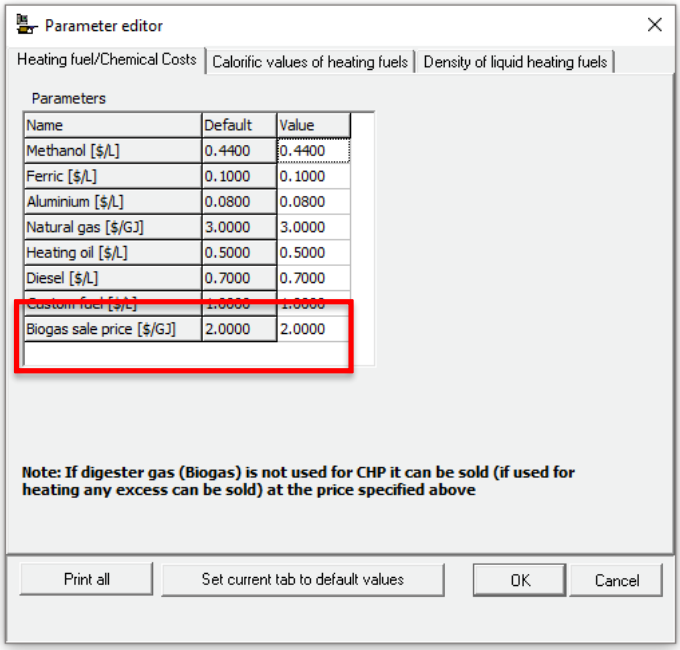


Costs for fuel consumption is readily captured in charts and tables:



Categories	Costs [$/hour]
Power	43.24
Chemicals	8.33
Fuel (Heating and/or Sale)	0.80
Sludge	10.24
-----	-----
Total	62.61

In BioWin 5.0, you could sell CHP-generated power back to the grid, as well as CHP-generated heat. ***BioWin 5.2 adds a third sellable item*** - anaerobic digester biogas:

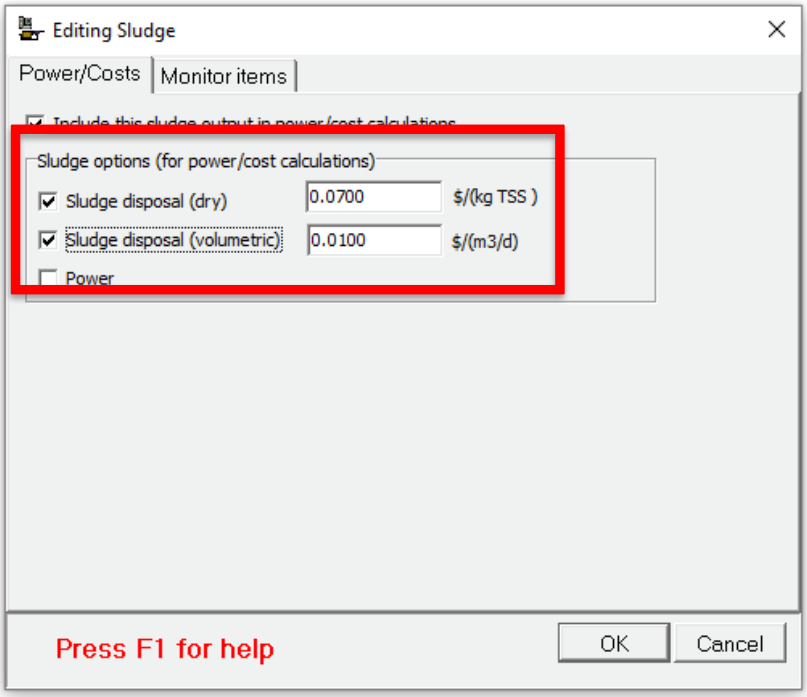


As with CHP power and heat sales, sale of digester-generated biogas will show up as a cost credit (negative cost) in cost charts and tables:

Categories	Costs [$/hour]
Power	9.56
Chemicals	4.11
Fuel (Heating and/or Sale)	-0.41
Sludge	0
-----	-----
Total	13.26

Costing Calculations – Sludge Disposal

BioWin 5.2 adds the ability to track sludge disposal costs on a unit volume basis in addition to BioWin 5.0's unit mass basis:

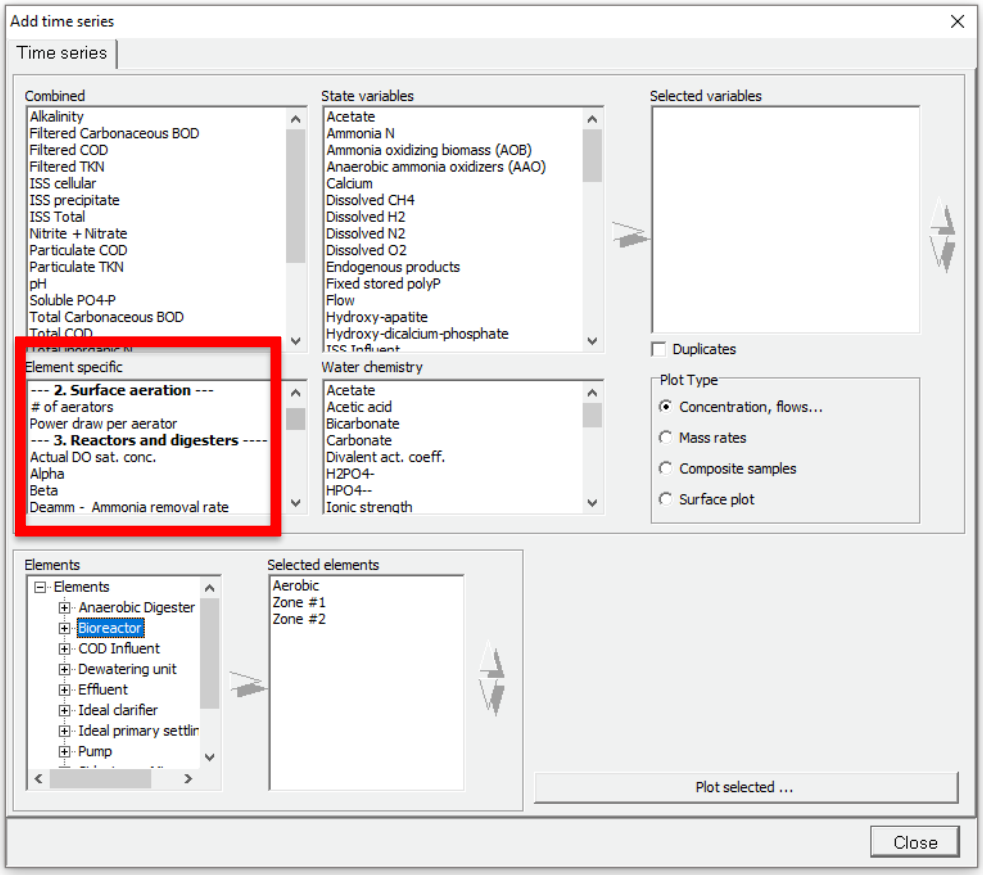


Usability Improvements

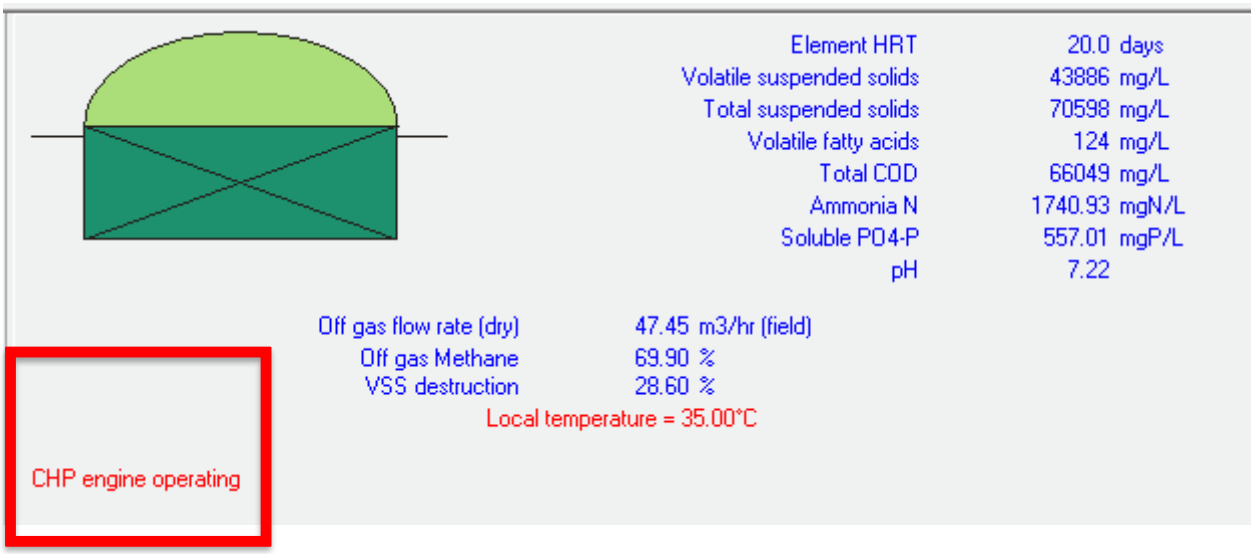
In addition to the new features above, a number of usability improvements have been made, including:

- Pop-up hints have been added to clarify pipe minor loss calculations in pump flowsheet elements.

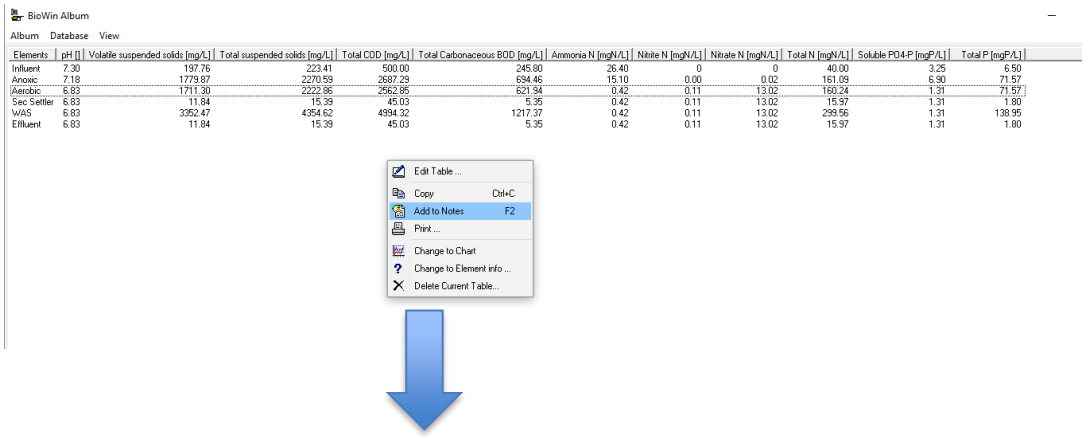
- The ability to plot aeration parameters alpha and beta has been added to the general time and current value series dialogue boxes:

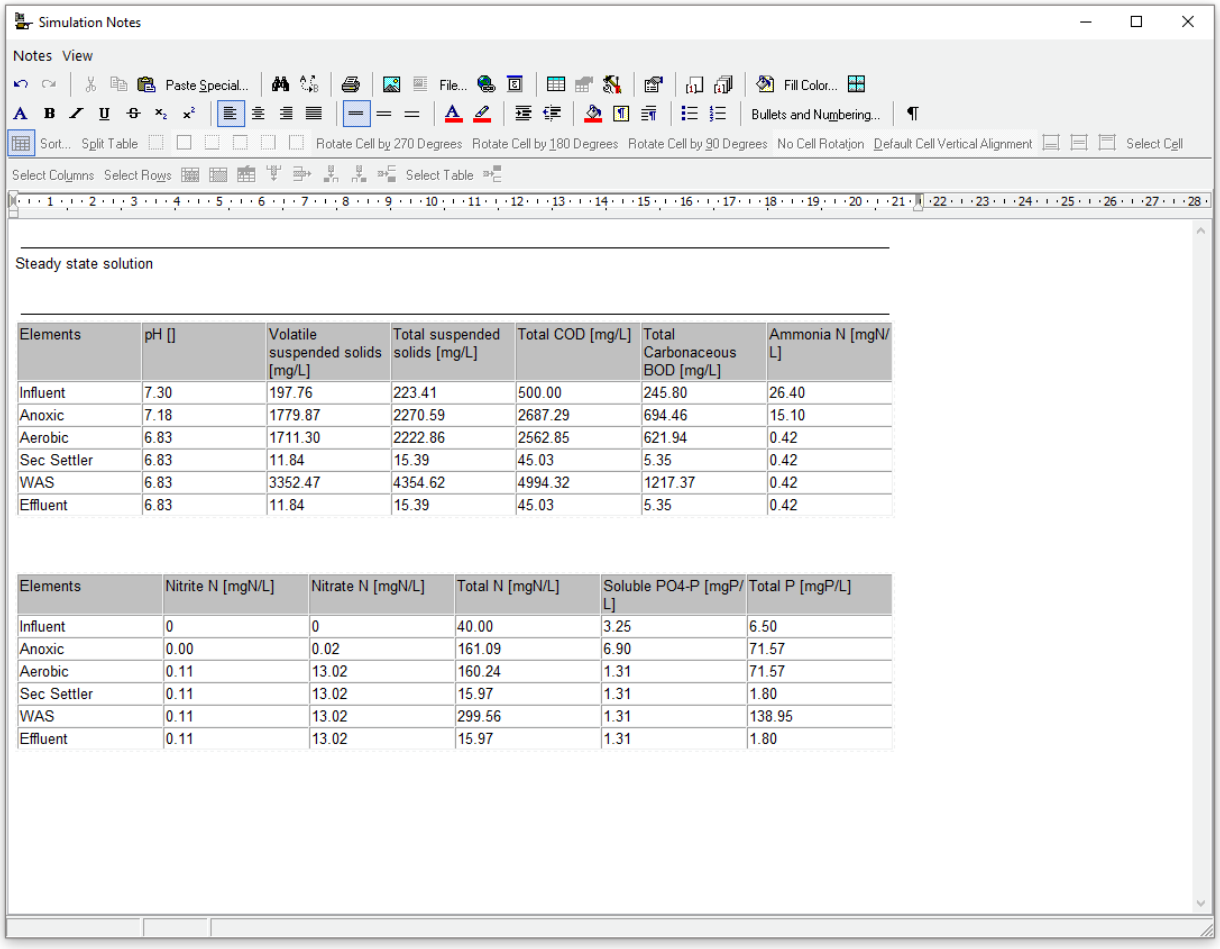


- If a CHP engine is associated with an anaerobic digester element, red text is shown in the fly-by pane as a visual indicator.



- Improved handling of how BioWin Album tables and charts are added to the BioWin Notes editor *via* the right-click **"Add to notes"** command. For example, tables are automatically formatted before being pasted to the Notes editor and tables with many columns are automatically divided into smaller tables that will fit the Notes editor:





Elements	pH []	Volatile suspended solids [mg/L]	Total suspended solids [mg/L]	Total COD [mg/L]	Total Carbonaceous BOD [mg/L]	Ammonia N [mgN/L]
Influent	7.30	197.76	223.41	500.00	245.80	26.40
Anoxic	7.18	1779.87	2270.59	2687.29	694.46	15.10
Aerobic	6.83	1711.30	2222.86	2562.85	621.94	0.42
Sec Settler	6.83	11.84	15.39	45.03	5.35	0.42
WAS	6.83	3352.47	4354.62	4994.32	1217.37	0.42
Effluent	6.83	11.84	15.39	45.03	5.35	0.42

Elements	Nitrite N [mgN/L]	Nitrate N [mgN/L]	Total N [mgN/L]	Soluble PO4-P [mgP/L]	Total P [mgP/L]
Influent	0	0	40.00	3.25	6.50
Anoxic	0.00	0.02	161.09	6.90	71.57
Aerobic	0.11	13.02	160.24	1.31	71.57
Sec Settler	0.11	13.02	15.97	1.31	1.80
WAS	0.11	13.02	299.56	1.31	138.95
Effluent	0.11	13.02	15.97	1.31	1.80

Further details on all new features in BioWin 5.2 can be found in the Help manual.