Pq: To start, get a good energy and material balance of your unit.

How do you know your plant is efficient?

Gathering all the required data proves it's well worth the effort

Nine out of 10 plants that I visit believe they're energy efficient. When I confront them with survey data showing their plant ranks low compared to their peers, I typically get one or all of the following responses:

- Our plant is unique and doesn't match the configuration of our peers.
- Our plant is old and for our equipment, this is as efficient as you can get.
- The comparison doesn't properly credit us for the energy it takes to run our unique one-of-a-kind double secret process.
- The data we gave were during a time when we had many upsets; therefore, it isn't a fair comparison.
- The data were taken during a time when we had a shutdown or an unplanned outage, which makes our energy use look high.
- It gets cold up here in the winter and we use more energy to heat.
- It gets hot down here in the summer and we use more energy to cool.
- Everyone else who answers this survey lies about their operations to make them look better. We are the only ones who are telling the real story.

So, how do you know if your plant is efficient? There's a use for peer survey data for quick comparisons, but calculating the excess energy supplied is probably the best method of knowing plant efficiency. The concept is simple but requires a lot of data gathering. However, the rewards are great, as you will know exactly where losses occur and what they cost you.

To start, get a good energy and material balance of your unit. Before using those data, ask yourself what are the main processes in your unit. Usually everything centers on reactions, separations (including distillations), or combinations. Isolate the processes and create boundary lines. For example, a gas plant may have five distillation columns. If all five do different things, then set boundary limits for each column or combine the heat requirements of each distillation. If two or more towers do exactly the same distillation, set the boundaries to include those columns as one process. Separate the unit into major processes that define what you are trying to accomplish and not processes that supplement or supply what you are doing. Therefore, if you create steam in your unit, don't include that as a process, but as a credit.

Once your processes are defined, calculate the base energy needed to bring your stream(s) from your storage condition to the process temperatures, pressures and phase. At this point, don't worry that the streams are coming "hot" from another process. A good process model, like HYSYS, can do this for you. For example, for a distillation column, bring the temperature, pressure and phase to the conditions at the bottom of the column. For endothermic processes that have additional heating requirements, add the theoretical extra heat necessary to your base energy need.

Compare energy requirements with energy supplied. Credit or debit energy transferred to other units or utility streams. In the distillation example, my bottoms stream runs hot to a tower in another unit, so I take credit for the delivery heat. However, if my feed stream came in hot from another unit, I debit that from my heat requirement. You cannot take credit for streams running hot to storage or exchanges within your unit.

In addition, know the efficiency of that delivered heat. If you have a furnace, it isn't the absorbed duty but the total duty. For electricity, determine the supplier efficiency. Any utility, compressed air, nitrogen, etc., also requires energy and you must estimate those values. Don't forget the energy it takes to supply cooling water and other streams. If you heat with steam, find out the steam system efficiency, how much energy did it take to create the energy you are using. Steam is tricky because you must know the system losses.

If the exercise is done correctly, you should get your units' overall efficiency, how much energy was theoretically needed versus the energy supplied. Best practice would be about 65% with most units around 45% to 55% and the worse from 15% to 35%. The numbers will vary and you need to understand if the variances are legitimate or something you forgot to calculate. Try the exercise on something small before tackling a big unit.

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