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Energy efficiency: Getting in early pays off exponentially

There are many situations and circumstances when it makes good sense to pursue energy efficiency for industrial processes. But when is the best time for such action?

Better operating practices. In existing facilities, improved operating disciplines and procedures often lead to significant energy savings without capital investment. Identifying real-time key performance indicators and optimizers can increase savings. Making data more accessible to operators and engineers through energy "dashboards" can reinforce better operating conditions and make them more sustainable.

Dedicated maintenance and energy "housekeeping" have a demonstrated track record of energy savings. Key areas to focus on include fixing steam leaks and monitoring steam traps, as well as repairing insulation and cleaning heat exchangers.

Revamps. Often, revamp projects are undertaken to increase energy efficiency through improved heat integration, steam/power system balancing, equipment upgrades, and, sometimes, fundamental process changes. However, even though the economics can be attractive, these projects are inherently difficult to justify and to implement because they require working within the confines of existing process unit and equipment. Furthermore, when replacing a piece of equipment with an "upgrade," you typically pay full price for the new item while only gaining the incremental benefit between it and the old equipment.

Optimized energy efficiency. The best economics for energy-efficient processes and equipment occur in new plant designs and major plant expansions. There are many different areas where energy efficiency can be "baked in" during various design stages of new facilities.

Basic technology selection. Early in design, the key issue is technology selection. Often, there are several competing technologies that can be used to achieve the required process objectives, such as material transformations and separations. Many factors must be considered. Due to the multi-dimensional nature of the selection parameters, the most energy-efficient option may not always be the top choice. Energy should always be a serious consideration in the selection procedure.

Beyond basic technology selection, there are many additional design decisions that affect the energy performance, such as:

Heat integration. It is often possible to recover additional energy from "waste-heat" sources without fundamentally changing the underlying process technology. Pinch analysis is a good technique used to identify such opportunities.

Equipment selection. Pumps, compressors, turbines, motors and other mechanical equipment can vary greatly in efficiency. It is often beneficial to invest a little more in high-efficiency machines to lower energy costs.

Process and utility interfaces. Individual process designs are very well optimized by contractors. However, material and energy are transferred between process units and utility systems, and the interconnections can vary. There are invariably opportunities to fine-tune the design. For example, this can include incorporating options for hot and/or cold transfer of materials from one process to another, adding steam turbines, generating steam from surplus heat, and changing steam header pressures.

Control. A great deal of energy is consumed in process control—for example, in throttling or recycling the discharge flow from pumps. Alternative control options, including variable frequency drive control, should be considered during design. In addition, excess air control of boilers and furnaces using stack gas oxygen and carbon monoxide measurements should be incorporated in new designs where appropriate. These measures can greatly improve overall equipment efficiencies and minimize environmental impact.

Maintenance facilities. Various maintenance activities are important for sustaining energy efficiency over the service life of a project. Examples include provision of bypass piping and valves to allow onstream cleaning of key heat exchangers, along with washing facilities for turbines and compressors, and cleaning facilities for boilers and furnaces.

Process design is a complex combination of science and art. Energy efficiency must never be handled in isolation from other design considerations. However, when properly managed, an energy efficiency assessment of the design for a new facility or for major expansions can lead to significant energy savings over the service life of the project and, consequently, provide an excellent return on investment. HP

EDITOR'S NOTE

Editorial is based on Dr. Rossiter's book, *Energy Management and Efficiency for the Process Industry,* published by AIChE/Wiley partnership, April 2015.

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