



# Improving Energy Performance of Industrial Systems

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An Application of Ideal-State Energy Benchmarking

Industrial energy consumers continue to look for ways to maximize energy savings, and reduce greenhouse gas (GHG) emissions associated with industrial systems and processes. Now, they can use ideal-state and target-based benchmarking standards. These standards provide a comparative performance metric that can be far more effective and accurate than current benchmarking methods.

## Who will benefit from adopting BEF



Industrial and large commercial facilities and operations



Municipal, provincial, territorial, and federal agencies



Manufacturers, vendors, and service providers



Utilities

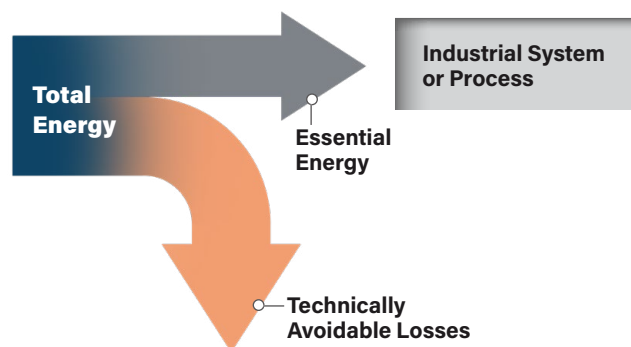


Energy consultants, managers, and other professionals

**Conventional benchmarking techniques** are based on comparisons of energy consumption of industrial systems or processes (ISP), which reflect differences in operating conditions, material and environmental conditions, changes in activity or economic structure, and other variable parameters. This can significantly limit the accuracy, reliability, and comparability of conventional benchmarking results.

**Ideal-state benchmarking** overcomes these challenges by comparing energy performance under actual operating conditions to an ideal requirement, using the ideal (essential) energy to set the benchmark. Essential energy is calculated using an energy model that represents the ideal state of the system and accounts for unavoidable energy losses.

The **benchmark energy factor (BEF)** is calculated as a ratio between total actual energy consumption and the essential energy required to do the work and obtain the desired output. BEF shows how close the actual energy consumption of a system or process is to its essential energy requirement. The difference between actual energy consumed and essential energy required is the technically avoidable loss. This represents the maximum amount of energy savings available through the optimization of a system or process.



# Benefits of using benchmark energy factors



## Optimized energy performance

As an indicator of energy efficiency, the BEF can identify opportunities for improvement and drive corrective actions to reduce energy waste, helping optimize operations and meet energy savings targets.



## Saving time and resources

Essential energy benchmarking models can help eliminate tedious normalization activities required to manage uncontrollable variables related to independent parameters.



## Improved reliability and accuracy

Ideal energy is a reliable baseline that takes into account variable independent parameters for effective benchmarking



## Protection of proprietary information

Production details and other sensitive information are not visible; only the calculated BEF is used to improve performance and compare similar processes.



## Continuous improvements

The BEF can encourage a culture of continuous improvement with sustainable performance measurement that evolves with the best available technologies, practices, and market developments.

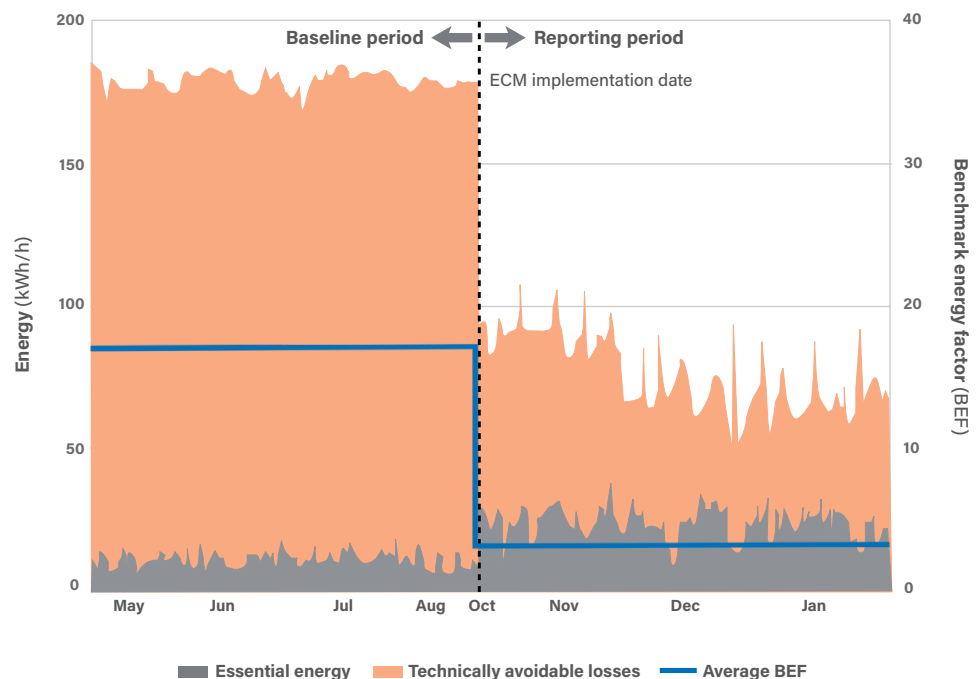


## Creating an industry-accepted reference

The benchmark energy factor standards can establish an industry-accepted reference instead of ever-changing user-defined methodologies conventionally used for benchmarking.

### Improving energy performance using BEF:

The performance of a pulpstock pumping system was optimized by downsizing the pump and using a variable frequency drive for flow control. These energy conservation measures saved significant energy even though production throughput increased the essential energy requirement, as illustrated by the change in BEF from 17 to 3.



## Available benchmark energy factor standards:

### Industrial refrigeration systems and facilities

- [CSA C500-18 \(R2022\), Monitoring and energy performance measurement of industrial refrigeration systems \(IRS\) using benchmark energy factor \(BEF\) concepts](#)

### Pumping systems

- [CSA C502:21, Benchmark energy factor assessment of slurry pumping systems](#)
- [CSA C504:20, Measuring and monitoring industrial and commercial pumping system energy performance](#)

### Industrial air movement

- [CSA C506:23, Benchmark energy factor \(BEF\) for industrial air movement systems](#)

### Data centres

- [CSA C510:21, Ideal state benchmarking and application of benchmark energy factor for data centres](#)

### Wastewater treatment facilities

- CSA C508, Benchmarking energy factor (BEF) assessment for wastewater treatment facilities (in progress)

## Additional resources:

### Technical specifications to help you understand concepts of BEF

- [CSA SPE-500-17, Conventional energy benchmarking and introduction to benchmark energy factor \(BEF\) for industrial systems and processes](#)
- [CSA SPE-501-18, Ideal state benchmarking and application of benchmark energy factor for industrial systems and processes](#)

### Training that helps you apply the method in practice

- [Benchmark Energy Factor online training](#)

**BEF spreadsheets following the BEF assessment methodology for easier calculations and analysis of process data (included in the standards, in development)**

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## Contact Us

Join the [CSA Energy Efficiency Community](#) to learn more or contact us at [EnergyEfficiency&Renewables@csagroup.org](mailto:EnergyEfficiency&Renewables@csagroup.org)

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The mission of CSA Group's Standards Development organization is to enhance the lives of Canadians through the advancement of standards in the public and private sectors. We are a leader in standards research, development, education, and advocacy. The technical and management standards developed with our more than 10,000 members improve safety, health, the environment, and economic efficiency in Canada and beyond.

