

Asset Decarbonization

Electrification

Why Electrification Matters in the Energy Transition

Electrification of industrial facilities is the design or retrofit of a facility to use electricity instead of steam or fuel gas. Most facilities can use electricity with lower carbon emissions than what is produced when using fuel gas or steam, thus reducing the facility's carbon footprint.

While electrification is simple in concept, there are many considerations that must be addressed for a successful project. For example, which equipment provides the largest reduction to carbon emissions if electrified, and does the facility's electrical distribution system have sufficient capacity and reliability for the potential changes in electrical loads?

- ▶ Improved energy efficiency
- ▶ Lower emissions of NOx, SOx and particulates
- ▶ Reduced water consumption and water treating requirements

Electrification Project Considerations

- ▶ Reduced operating costs
- ▶ Lower capital costs
- ▶ Increased reliability

High-Impact Methods in Electrifying Industrial Facilities

From Fluor's 30 years of experience performing electrification projects, the following three electrification options provide the largest impact to emission intensity and energy efficiency in an industrial facility:



Electric motors instead of steam turbines



Electric heaters



Heat pumps on columns

Electrification methods with the largest impact to emission intensity and energy efficiency.

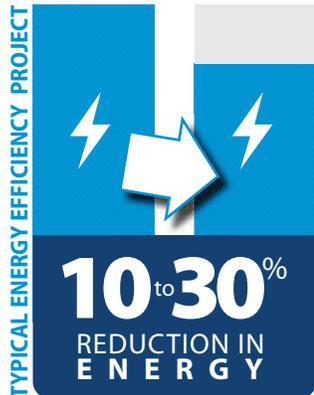
Reduced Fuel Gas Demand Opportunities from Electrification

Electrification typically reduces fuel gas demand of a facility, providing the following opportunities:

- ▶ Separate and sell propane and heavier material from fuel gas
- ▶ Combine an electrification project with a gas-to-liquids or syngas project
- ▶ Minimize or reduce outside fuel gas purchases

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Energy Efficiency



Benefits of Energy Efficiency and High-impact Methods

Energy efficiency optimization reduces a facility's required energy consumption.

Reducing energy consumption mutually delivers decarbonization benefits and provides an economic return.

High-Impact Methods to Increase a Facility's Energy Efficiency

- ▶ Optimize heat recovery systems
- ▶ Apply energy optimization best practices
- ▶ Select equipment and technologies based on their energy intensity
- ▶ Compare designs to known benchmarks

Optimizing Projects' Energy Efficiency through Proven Tools and Practices

Fluor takes a systematic, rigorous approach to understand our clients' existing assets and needs. By leveraging our technical expertise in process and electrical engineering, we can readily determine the best options for each project and facility.

Process Design Enhancements

- ▶ Apply flare gas recovery, mechanical vapor recompression, high-performance heat transfer and distillation equipment, and optimum energy sources
- ▶ Design for recovery of waste heat and ideal integration of waste streams
- ▶ Implement effective process control strategies to achieve unit objectives while reducing energy consumption
- ▶ Work with equipment and technology suppliers to enhance their designs
- ▶ Use nested layers of optimization and proven, best available technology

Design Practices

- ▶ Execute value improving practices such as energy optimization, process intensity, and process simplification
- ▶ Design to an appropriate balance between operating cost and energy inputs versus capital expenditures, such as optimizing insulation thicknesses or pipe sizes
- ▶ Find potential energy efficiency value by modelling systems and using heat integration analysis software that develops composite curves and clearly shows pinch points
- ▶ Determine energy intensity by process unit and benchmark against best-in-class designs

Through proven tools, your project or facility's energy efficiency can be optimized to meet economic and environmental needs.