INCREASING PROFITABILITY THROUGH ENERGY EFFICIENCY

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Introduction

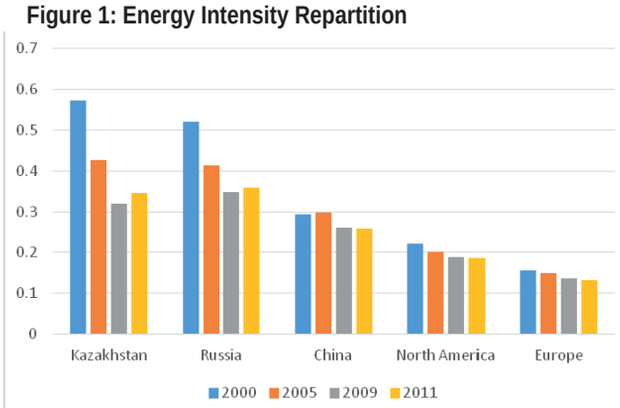
In a difficult economic environment, companies have to identify opportunities to improve their margins at an affordable investment cost. For example, Energy Efficiency is often considered as a constraint for a company or even a country. Nevertheless, Energy Efficiency is a major opportunity to transform "lost energy" into additional revenue. In Kazakhstan, this "lost energy" can be transformed into additional export sales of gas and crude oil and will represent an additional revenue for the country. In addition, it will benefit companies by reducing their energy bill.

Energy Efficiency could also be named Hidden Fuel. Nevertheless, over the last 20 years, Hidden Fuel became First Fuel in the 11 member countries of the International Energy Agency (IEA). The saved energy resulting from Energy Efficiency programs was equal to 1.52 billion tons of oil equivalent in 2010 while the oil consumption was lower (1.04 billion tons).

In Kazakhstan, this Hidden Fuel has been quantified to be around 8 to 10 billion USD per year, considering all the energy consumers, thus representing over 10% of Kazakhstan's oil production.

This high potential is linked to Soviet industry's historical heritage. Kazakhstan was still among the High Energy Intensity countries in 2011 (EI>0.3) even if Energy Intensity was drastically reduced in comparison to 2000.

Figure 1: Energy Intensity Repartition



Total Primary Energy Consumption per Dollar of GDP (kep / USD Year 2005)

Source: International Energy Statistics - Knoema – EIA (August 2014)

Energy Efficiency Project and AKEE

In order to support the effort of Kazakhstan industry in "drilling and producing" this "Hidden Fuel," Axens and Kazgiproneftetrans (KGNT) created in 2014 the "Axens KGNT Energy Efficiency" (AKEE) Joint Venture LLP. AKEE is an accredited Energy Auditing company and its objective is to deliver high quality and professional services to enhance Energy Efficiency in Kazakhstan.

During an Energy Efficiency Improvement Project, a team of experts will collect energy consumption data and compare them with an international database of Key Performance Indicators (KPI) for specific applications (process, equipments, etc.). Then, based on International Best Available Techniques (BAT), they will develop solutions to save energy classified according to their attractiveness in order to identify the most profitable ones.

With more than 20 projects for Energy Efficiency Improvement, Axens has acquired significant know-how and developed numerous tools. Among them, the Pinch Analysis has been frequently used to identify potential energy saving in process units with a large number of heat exchangers.

Energy Conservation Tools

Pinch Analysis is a systematic methodology for energy-saving based on thermodynamic principles developed by Linnhoff March in the late 1970's. It needs limited information about material (flow rate) and heat balance (temperature T, specific heat capacity Cp and enthalpy H). This method is useful to compare two networks, identify inefficient exchangers or assess the minimum energy (cold/hot utilities) required by the system and thus the maximum potential for improvement of a given scheme (the target). Pinch Analysis never provides a direct solution, but rather ways to improve. Moreover, this methodology cannot take into account specific process requirements or operating constraints.

In order to get the best from Pinch Analysis, AKEE associates it with a dedicated in-house software named CREO, which makes possible to impose process flexibility constraints to optimize heat exchanger networks.

CREO - Linear Programming Model:

CREO is a Linear Programming mode, to determine optimal heat exchanger network solutions for process flow schemes, taking into account operational and flexibility constraints. These constraints are specific to each process technology and should allow operation of the plant with sufficient flexibility while achieving target performance. As an example, some of these constraints are summarized below:

- Process heat exchange restrictions to avoid either contamination issues or safety issues
- Mandatory heat exchanges between two fluids
- Avoiding use of hot or cold utility on a given process fluid
- Fired heaters minimum duty requirement for either start-up or control considerations
- Heat exchangers bypass needs for operational flexibility
- Hydraulic limitations such as the head requirement for recycle compressors
- Minimum temperature approach across specific exchangers

The CREO model objective is used to develop an energy conservation solution that offers the best compromise between CAPEX and OPEX, while affording customized operational flexibility.

Pinch Analysis for Existing Assets

The Pinch Analysis tool is frequently used for evaluating an existing heat exchange network for minimum utility requirements (duty and temperature):

- *Process Composite Curve:* Determines process overall utility consumption targets, calculates process pinch temperature and identifies "cross pinch" heat exchange.
- *Process Grand Composite Curve:* Defines a target for each type of utility consumption.

Energy Efficiency and Clean Fuel in Kazakhstan

In oil refineries, Fluid Catalytic Cracking (FCC) produces substantial amounts of naphtha from heavy oil fractions and contributes largely to the gasoline pool. In order to produce low sulfur gasoline and high octane, the Prime G+ technology selectively hydrotreats the FCC gasoline. Prime G+ technology is the leading FCC selective hydrotreatment technology.

In Kazakhstan, Axens has already licensed Prime G+ technology in all refineries and therefore provides this contribution to cleaner motor fuels in Kazakhstan and lower air pollution.

Focusing on Energy Efficiency, the following figures illustrate the economical evaluation for a specific Axens FCC Gasoline hydrotreater (Prime G+), where the energy savings are optimized as a function minimum approach temperature (DT_{min}).

Figure 2: Typical Prime G+ Composite Curve

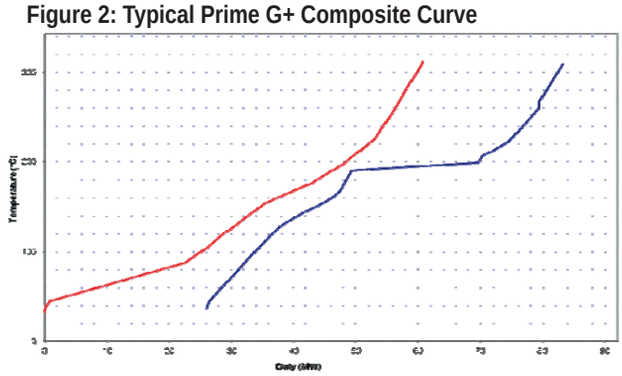


Figure 3: Typical Prime G+ Grand Composite Curve

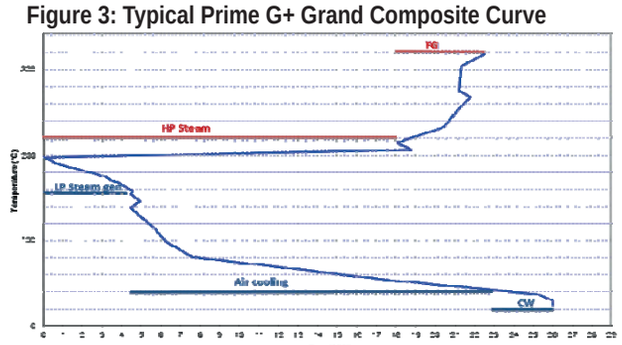
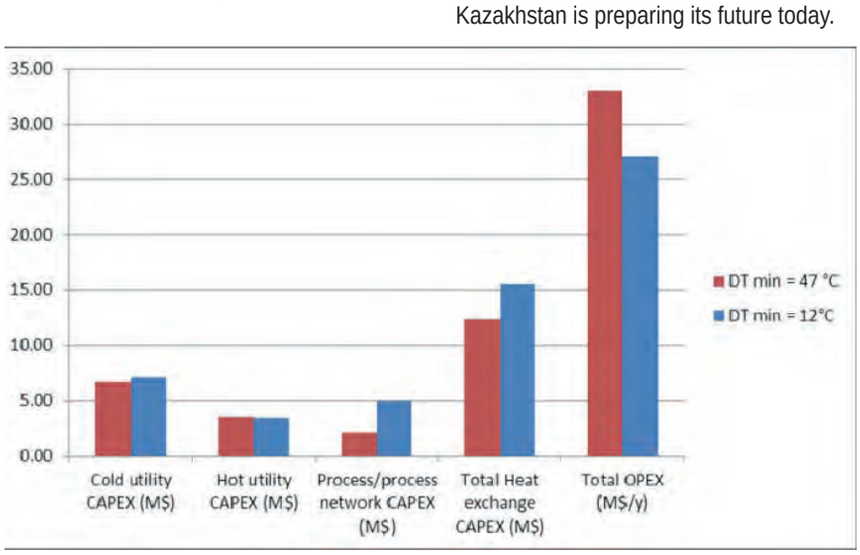


Figure 4: Investment Cost (CAPEX) and Operating Cost (OPEX) Evaluation versus Minimum Temperature Difference (DT_{min})



Axens Recent Experience in the CIS Using Pinch Analysis and CREO

Axens recently managed a revamp case in the CIS region to debottleneck the capacity of a block of refining units composed of a Vacuum Gasoil Hydrotreating Unit (VGO HDT) and Fluid Catalytic Cracking Unit (FCC), along with a better performance and improved energy efficiency.

This project went through different steps to ensure proper execution and fulfilment of the client's expectations at the lowest possible cost:

- *First step* - a feasibility study consisting of identification of main bottlenecks and selection of the (economical) optimum capacity for the units
- *Second step* - a scoping study with a higher level of precision to confirm project profitability
- *Third step* - a deep analysis including a full site survey and a thermal integration study to identify a preferred scheme taking into account process and site constraints

Finally, Axens developed a complete basic design package for the revamping of these units. The benefit from Energy Efficiency improvement allowed reducing the energy consumption by 43% while justifying a pay-out time of 4 years.

Conclusion

AKEE and Axens have a dedicated team of experts working exclusively to improve energy conservation and flow scheme optimization encompassing for process intensive industry (Oil & Gas, Power, Metallurgy, Chemical, etc.).

Since its creation, AKEE has been awarded two large energy audits in Kazakhstan for KazMunaiGas Refining and Marketing at petrochemical refineries in Pavlodar and Atyrau. For each project, CREO and Pinch Analysis will help identifying potential energy saving.

The AKEE objective is to be self-sufficient in both engineering terms and economic terms, meaning that our services must be fully developed in Kazakhstan. Through local recruitment of engineers, training, and execution of complex projects, we will reach our objective.

While reaching this target, we will serve Kazakhstan's industry by providing a large portfolio of solutions to save energy in the country and indirectly protect the environment. Through sustainable development and a shift towards the Green Economy, Kazakhstan is preparing its future today.