MANCHESTER 1824
The University of Manchester

STAR Overview

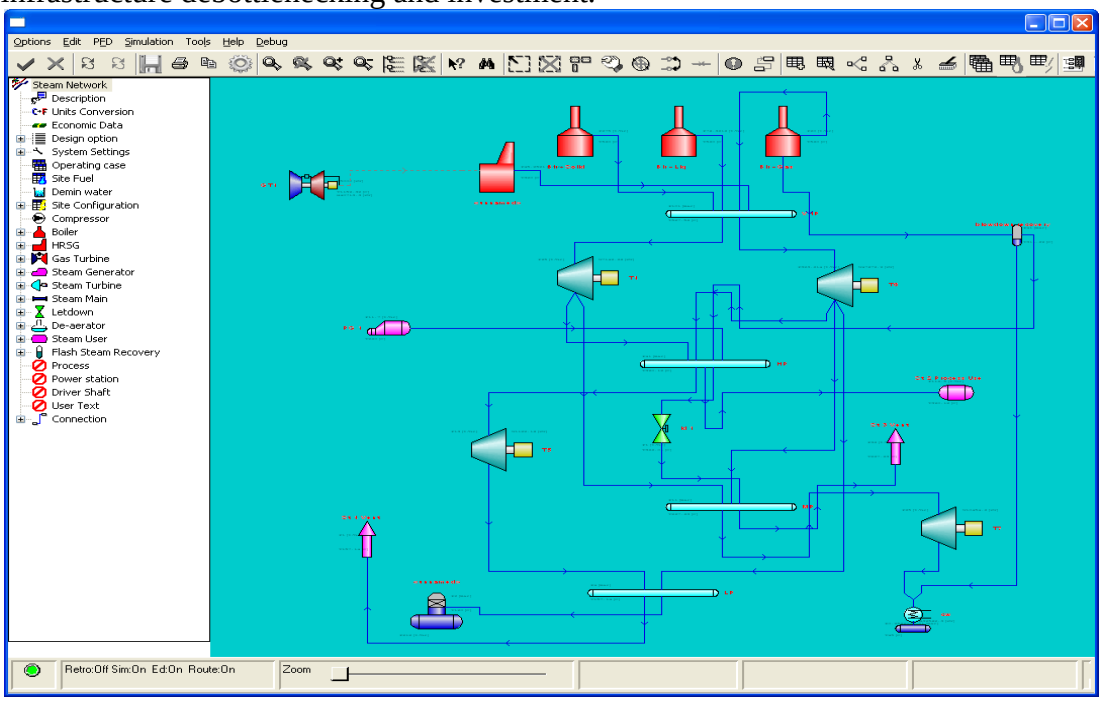
STAR is a software package for the design of site utility and cogeneration systems. The interactions between the processes on the site and the steam system, steam turbines, gas turbines (with auxiliary firing options), boiler house, local fired heaters and cooling systems are all analysed using **STAR**. It can be used for reducing energy costs or planning infrastructure investment in situations where changes to operations on the site are anticipated or energy equipment needs to be replaced. The most effective capital investment strategy can be investigated. **STAR** can also be used to investigate the reduction of flue gas emissions to meet tighter environmental regulations.

Issues addressed by **STAR** include:

- Understanding site utility infrastructures
- Optimising existing utility system configurations
- Targeting cogeneration potential
- Choosing the most appropriate cogeneration system
- Optimising site steam pressures and loads
- Design and operation of steam turbine networks
- Minimising energy costs for the site
- Reducing flue gas emissions from the site

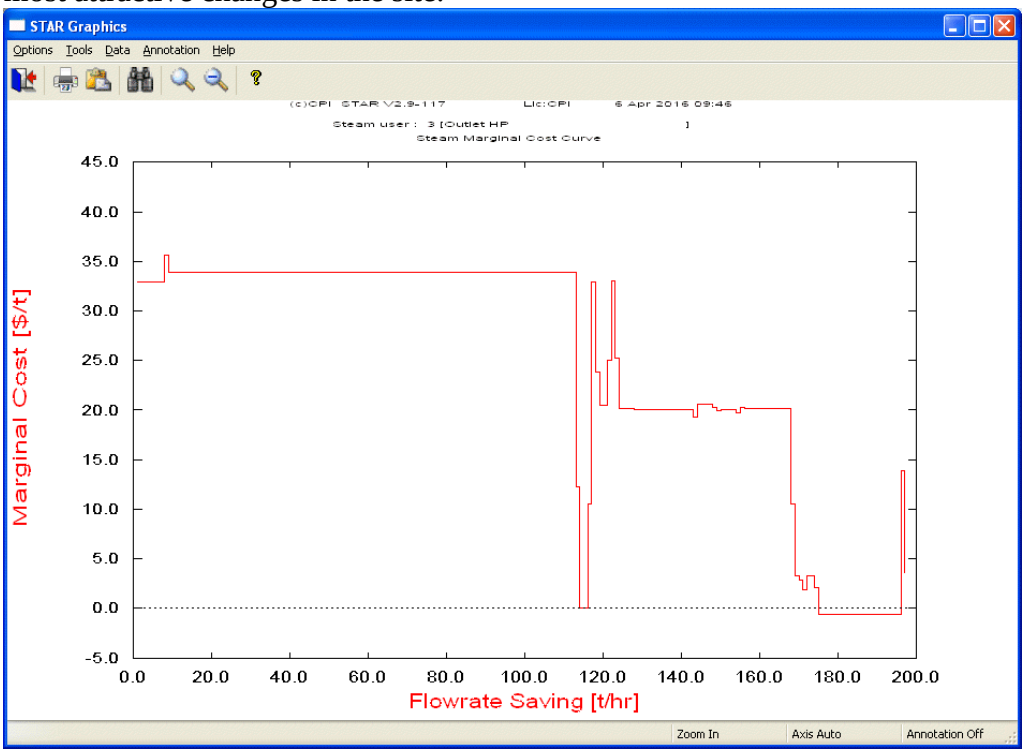
Utility System Optimisation

A given utility system configuration incorporates important degrees of freedom for optimisation. Multiple boilers with different efficiencies and different fuels, multiple back pressure steam turbines, condensing turbines, gas turbine heat recovery steam generators and letdown valves provide optional heat flow paths that can all be exploited for significant cost reduction. **STAR** has a utility system optimisation facility that allows existing utility systems to be optimised. It can also be used to plan infrastructure debottlenecking and investment.



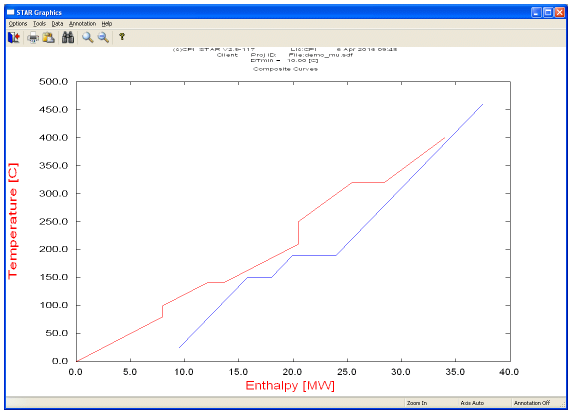
Steam Pricing

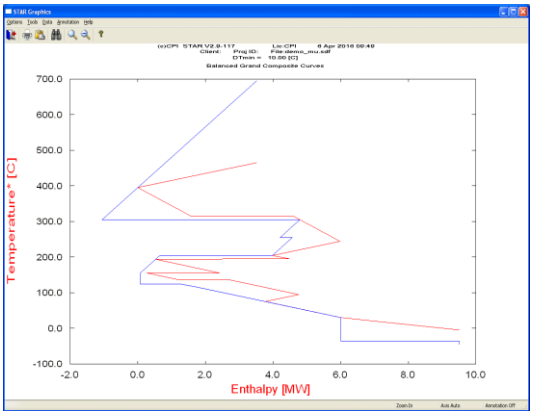
When studying existing sites processes it is important to understand the way in which the existing site infrastructure influences the degrees of freedom to make changes and the economic consequences of any changes. This is provided by **STAR** in its Steam pricing such that the designer does not waste time pursuing changes which will neither be viable nor economic in the context of the overall site. The designer is thus no longer overwhelmed by the multitude of options available for change, but directed to the few most attractive changes in the site.



Process Energy Targets

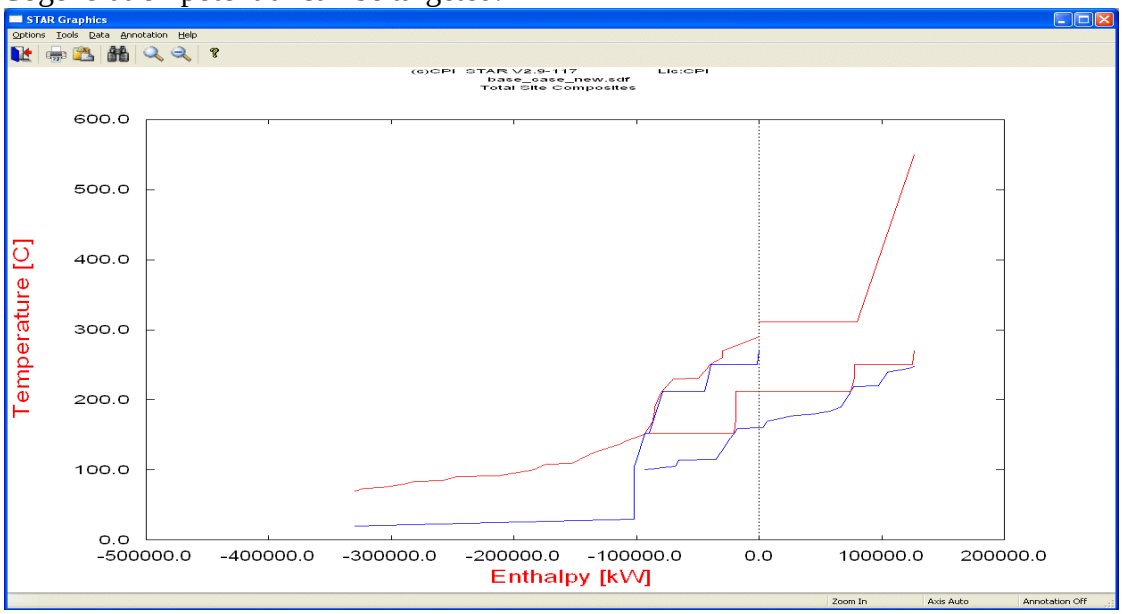
Even though the prime function of **STAR** is the analysis of utility systems, it has tools available to set energy targets and select utilities for individual processes. Using these tools allows the picture of the total site to be built up from the individual processes within **STAR**. These tools include the composite curves, the grand composite curve, and the problem table, that enable the engineer to predict hot and cold utility targets for individual processes.





Total Sites

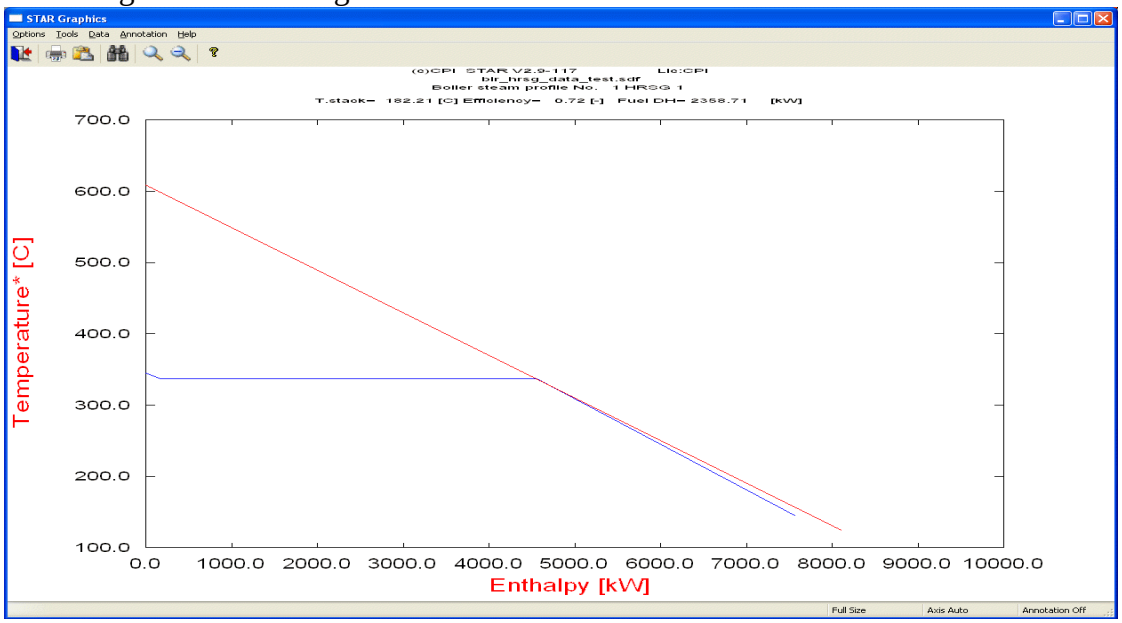
Processes are most often linked to a common utility system involving multiple levels of steam and power generation. Processes consume steam but some also generate steam from high temperature heat sources. The generation of steam provides heat recovery through the steam system. The site imports or exports power to balance the power generated. **STAR** can produce total site profiles representing the heating and cooling requirements of the site. This allows targets to be set for fuel consumption in the boilers, cogeneration potential and energy costs. Profiles can be based on either the full heat recovery data or more simply from the data for the utility exchangers only. Cogeneration potential can be targeted.



Site composite curves illustrating heat recovery between processes via the site steam system

Boiler Systems

STAR is able to optimally target the amount of steam generated for process use by boilers and gas turbines (with auxiliary firing options). A gas turbine model allows different gas turbine arrangements to be studied.



Emissions

By relating the energy requirements of the processes to the supply of utilities, it is possible to target for the amount of fuel required for the utility system. These targets can be combined with information on the fuel and type of combustion device to provide targets for CO2, SOx, NOx and particulates. The various options to reduce emissions can then be explored using **STAR**.