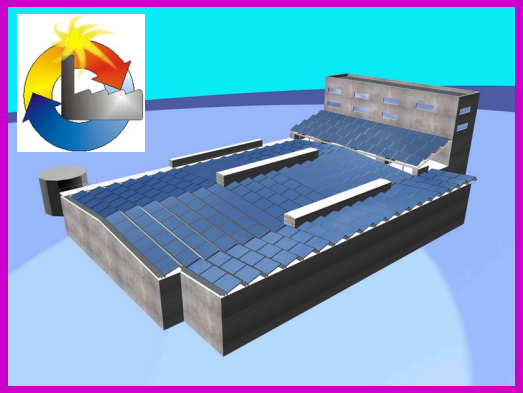
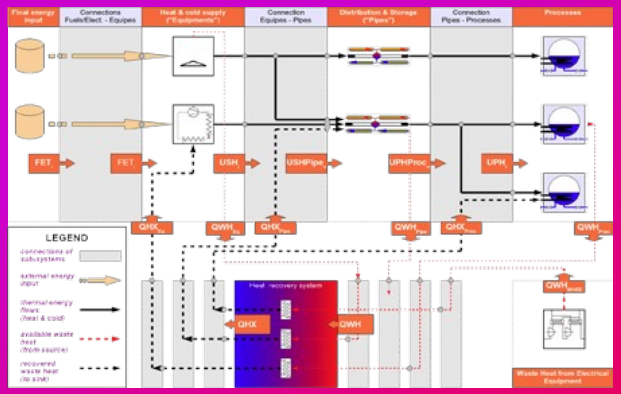
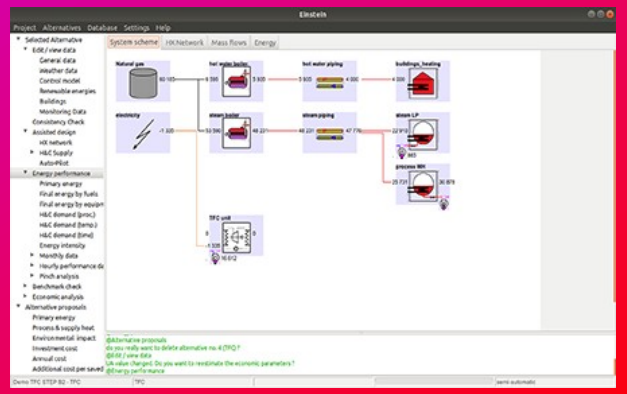
EINSTEIN energyXpert







Expert System for Heat Recovery, Renewable Heating and Cooling and Distributed Power Generation

www.einstein-energy.net

What is EINSTEIN - use cases and target groups

- Originally developed for optimisation of industrial heating and cooling systems

- Applicable also for other (large) consumers of thermal energy, e.g.:
  - big buildings (commercial centers, office buildings, hotels, sport centers, etc.)
  - district heating and cooling networks

- EINSTEIN is a comprehensive tool-box for:
  - feasibility analysis / comparative analysis of different system options
  - system design and dimensioning of main components
  - system simulation and evaluation of energy, environmental and economic performance

- Target groups:
  - energy engineers involved in system design
  - energy auditors



Use Case System Design

	one-spot detailed design	periodic quick energy audit
stage of project development	both green field design and retrofit	retrofit
typical frequency	every 2 – 5 years	once a year
effort / detail level	high	low (high degree of automatic processing)
result	catalogue of measures for a structural change within the system (installation of new or change of equipment, ...)	detection of the need (or not) for a change / update in the system measures for incremental adaptation of the system (e.g. increase of size of an existing heat exchanger, ...)

European Union's Horizon 2020 research and innovation programme
grant agreement No 680599

Features (1): data collection and checking

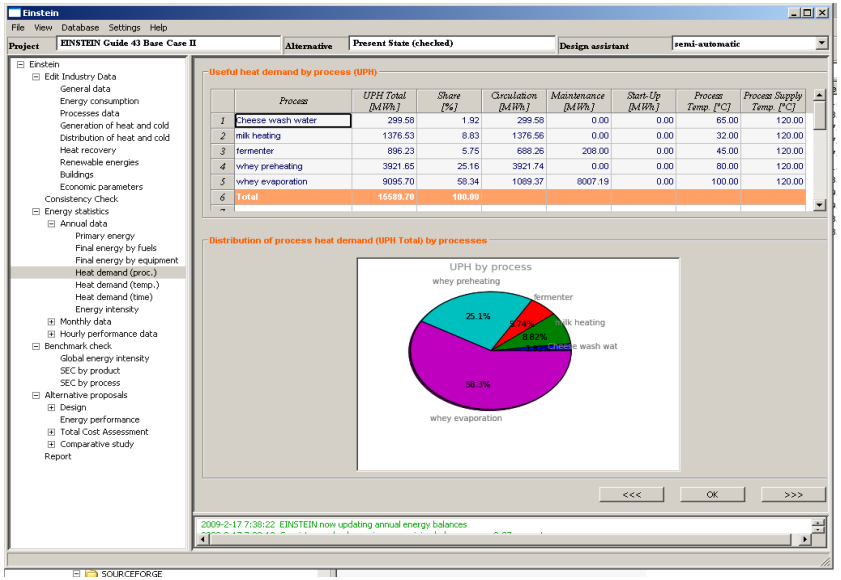
- data collection
  - manual data input
  - import of data files (full and partial sets of time series or cumulative data for periods)
  - allow for both redundancy and “white spaces” (don´t know´s)
- consistency and completeness checking
- estimation of missing data
  - useful workaround for fast assessment with lower requirements on accuracy
  - alternative to costly and time consuming measurements or data inquiries
- objective: set-up of boundary conditions as starting point for optimisation:
  - load profiles (flow rates, temperatures), ambient conditions, etc.

Features (2): detailed breakdown and analysis of energy flows

- detailed breakdown of energy consumption:
  - by processes, equipment and energy sources
  - all heat flows as a function of **temperature and time**: Q = Q(T, t)

- pinch analysis
  - energy targets and starting point for the design of the heat recovery and supply systems (heat pumps, heat to power conversion)

- presentation in form of tables and graphics



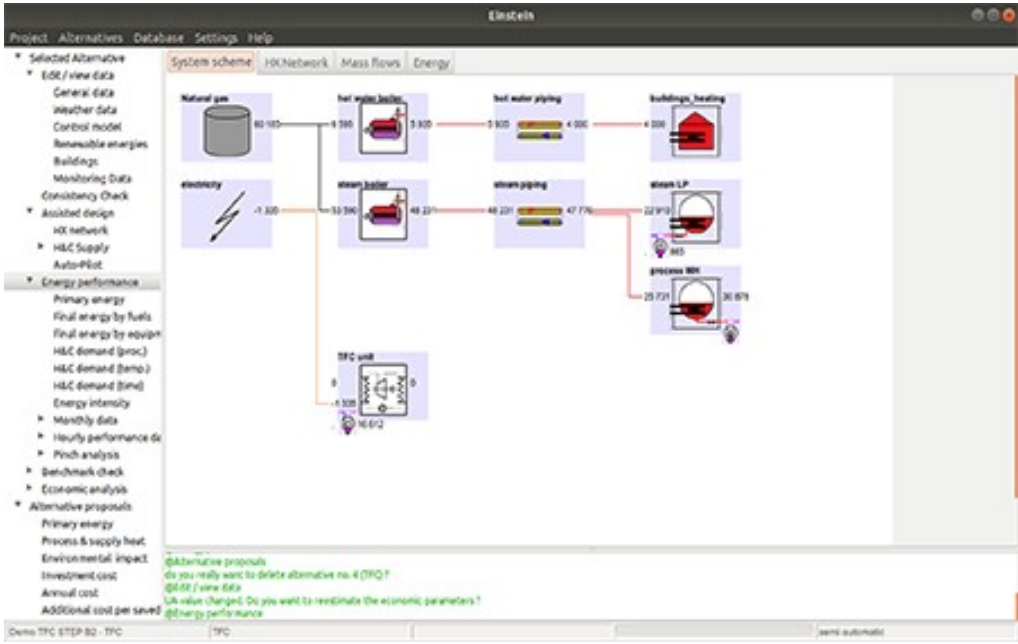
Features (3): assisted design of alternatives

- assisted semi-automatic design of several system alternatives
  - automatic design of heat exchanger networks
  - automatic (pre-)selection and (pre-)dimensioning of equipment (e.g. heat pumps, CHP, solar thermal)

Features (4): dynamic system simulation

- module for dynamic system simulation
  - hourly simulation of one year as standard
  - lower time steps and different simulation periods possible

- designed for quick set-up of simulation models
  - easy to use, no need for expertise in simulation tools
  - minimum set of mandatory input parameters
  - configuration based on energy flows
    - no explicit definition of detailed hydraulic configuration (e.g. pumps, mixing valves) and corresponding control strategies necessary
  - control of heating and cooling supply based on thermodynamic „best match“ of demand and supply „composite curves“ analogous to pinch analysis



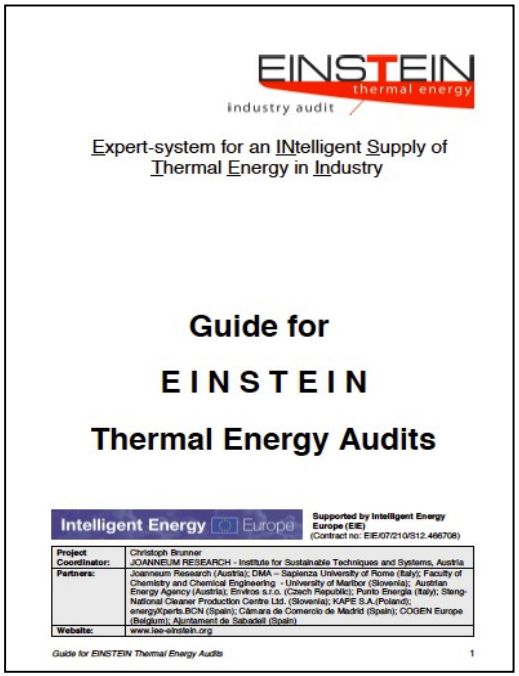
Features (5): economic and environmental analysis; report

- Modules for economic and environmental analysis
- Automatic generation of a comprehensive report
  - printable and editable (Open/LibreOffice format)

Methodology and theoretical background

- Standard for energy accountancy and definition of temperature levels
- Standard generic process model
- Clear and transparent definition of concepts for economic and environmental analysis

  => *EINSTEIN Guide for Thermal Energy Audits*


EINSTEIN thermal energy industry audit

Expert-system for an INtelligent Supply of Thermal Energy in Industry

Guide for

EINSTEIN

Thermal Energy Audits

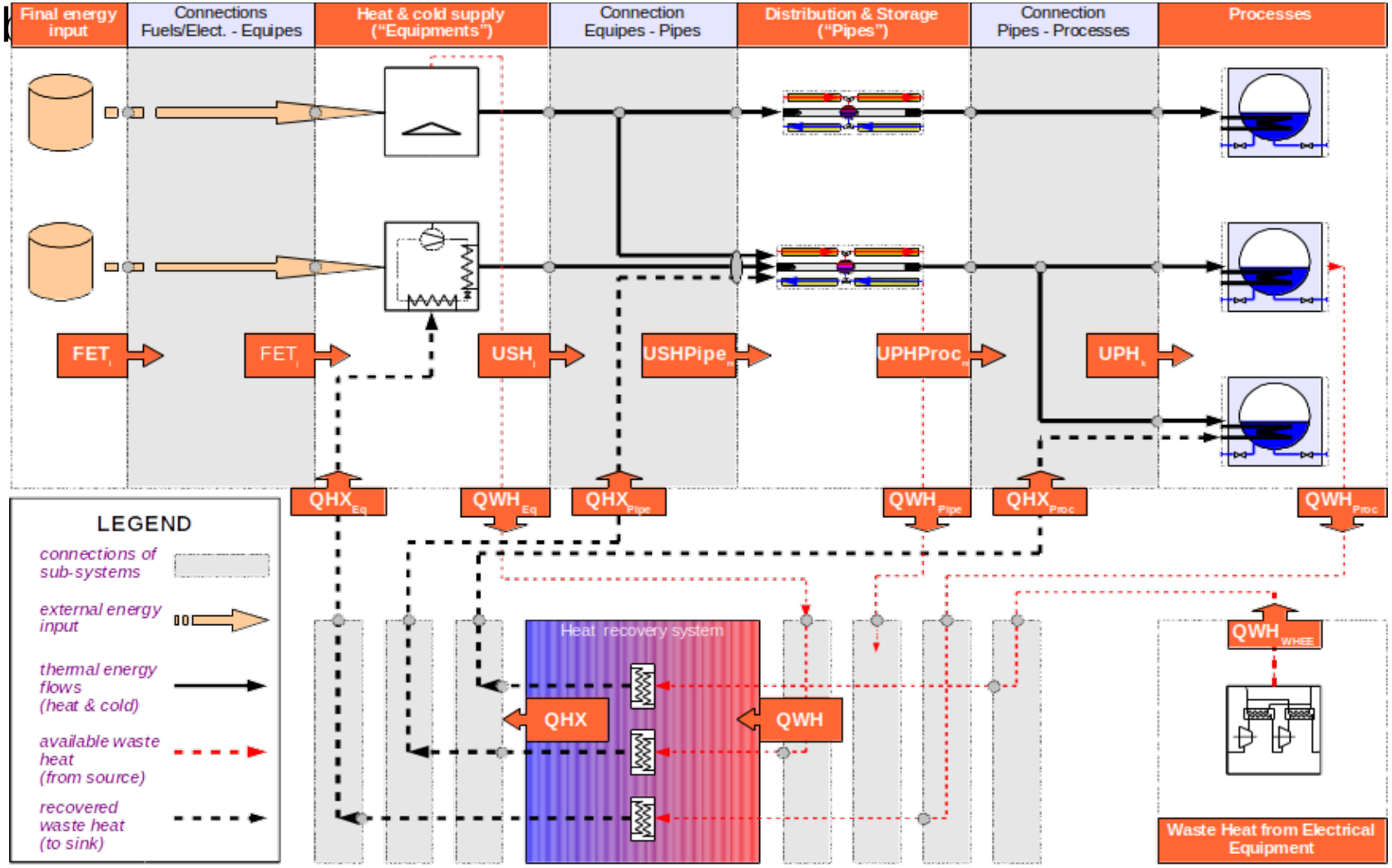
Intelligent Energy Europe

Supported by Intelligent Energy Europe (EIE)
(Contract no: EIE/07/210/S12.466708)

Project Coordinator:	Christoph Brunner JOANNEUM RESEARCH - Institute for Sustainable Techniques and Systems, Austria
Partners:	Joanneum Research (Austria); DIMA – Sapienza University of Rome (Italy); Faculty of Chemistry and Chemical Engineering - University of Maribor (Slovenia); Austrian Energy Agency (Austria); Enviros s.r.o. (Czech Republic); Punto Energia (Italy); Steng-National Cleaner Production Centre Ltd. (Slovenia); KAPE S.A.(Poland); energyXperts.BCN (Spain); Cámara de Comercio de Madrid (Spain); COGEN Europe (Belgium); Ajuntament de Sabadell (Spain)
Website:	www.iee-einstein.org

Guide for EINSTEIN Thermal Energy Audits 1

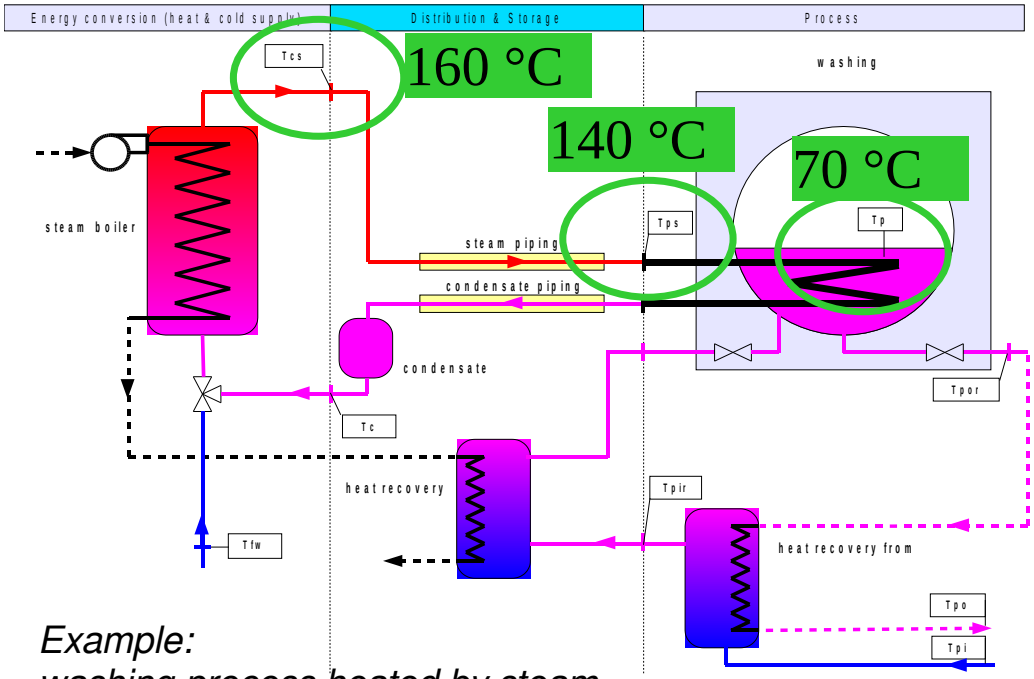
- Definition of enery flows and sub-system



Definition of temperature levels

- PT: process temperature
  - temperature of the process medium
- PST: process supply temperature
  - temperature of the medium in the heat supply (inlet to process)
  - in addition distinction PST in actual system vs. minimum required PST
- CST: central supply temperature
  - temperature of the medium in the heat supply (e.g. outlet of boiler)

- Often big differences PT/PST/CST
- Temperature levels can be optimised (reduced)
  - big potential for heat recovery and application of energy efficient supply technologies at lower temperatures

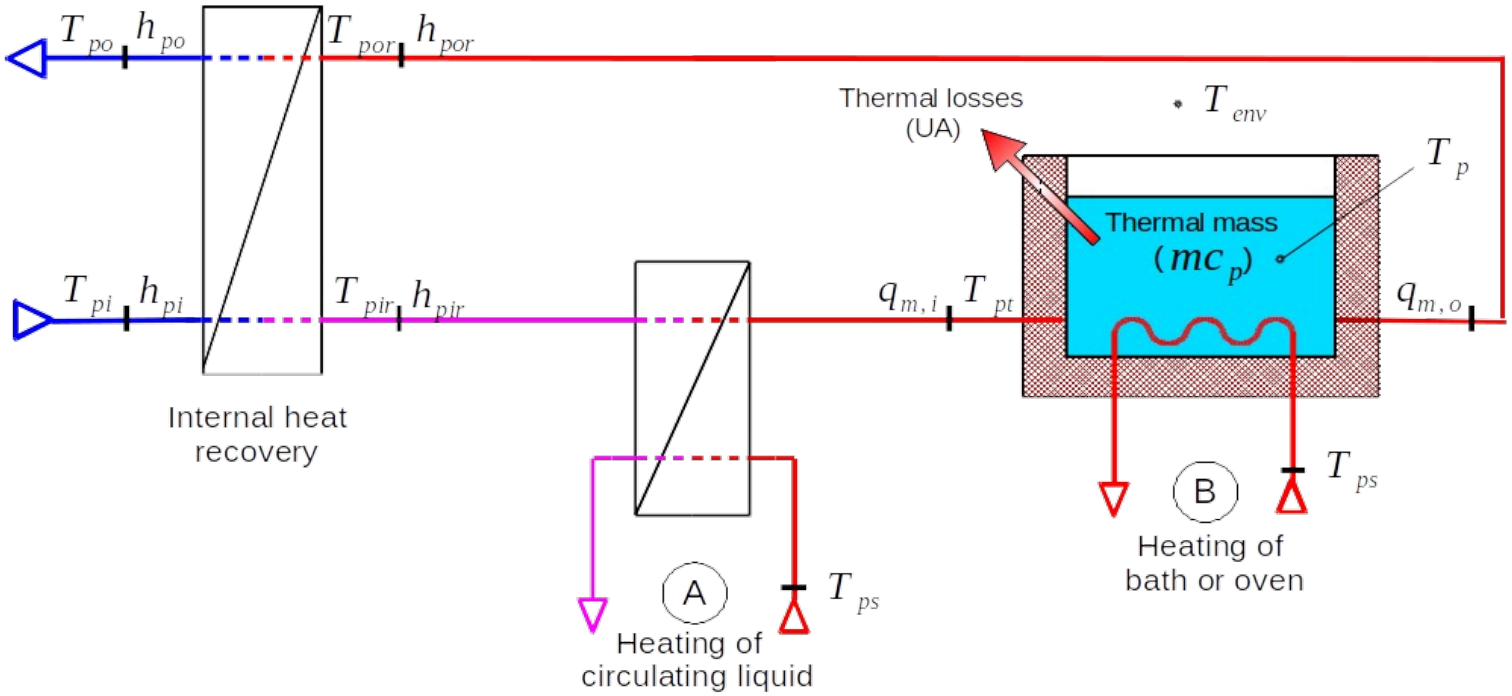


Example:
washing process heated by steam

Standard generic process model

- in- and outflowing streams
- thermal losses
- internal heat sources / sinks
  - e.g. chemical reactions, phase change, mechanical power input

- thermal mass
  - variations of temperature, e.g. initial heating-up and final cool-down



History

- 1999 - 2006: early work. Origin: need for fast design of systems for solar process heat (European project POSHIP: potential of solar heat for industrial processes; IEA-SHC/SolarPACES Task 33/IV)

- 2007 - 2012: EINSTEIN Versions 1.0 and 2.0 developed within the European projects EINSTEIN I and II.
  - training courses and energy audits in many European Countries
  - translation of EINSTEIN Guide and software tool into several languages (DE, ES, FR, IT, CZ, SK, SI, PL, FI, BG)

- 2013 - 2015: Development of a commercial version EINSTEIN *plus* with a new and faster module for dynamic system simulation in parallel to the free and open source version.

- 2015 - 2020: Version 3.0: Graphical system editor and other improvements of user friendliness, new features (heat to power, cost and environmental parameters of electricity grid as a function of time). Support through the European project i-ThERM (www.itherm-project.eu).

- 2021 (ongoing): Update and improvement of modules with specific focus on renewable heating and cooling (heat pumps, solar thermal and PV).

Thanks for your attention !

For further information:

www.einstein-energy.net

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