



Expert system for an intelligent supply of thermal energy in industry

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General information		notes	Statistical and economical data		notes
name of the company		<i>legal name of the company</i>	number of employees	-	
city / country		<i>city where production is located</i>	annual turnover	M€/year	
name of contact person			annual production cost	M€/year	<i>Specify total factor inputs for production</i>
position of contact person in the company			base year for economic data	-	<i>Specify the reference year for economic parameters</i>
address			growth rate of the production volume foreseen for the next 5 years	%/year	
Telephone No			Is the company independent ?	yes/no	
Fax No			yearly O&M heat & cold	€/year	
E-mail			yearly O&M electrical	€/year	
description of the industry			Period of operation		notes
branch			total hours of operation per working day	h/day	<i>e.g. 3x6 hours = 3 turns of 6 hours each</i>
NACE code branch			number of shifts	-	
sub-branch			days of production / operation per year	days	<i>Specify holiday periods and periods of stops for maintenance</i>
NACE code sub-branch			principal period of holidays or stops for maintenance	dd/mm-dd/mm	

Information on products		Product 1	Product 2	Product 3	Other products	notes
type of product	name					
product's code	-					
quantity of product(s) per year	product-units/year					
measurement unit for product quantity	-					<i>Specify the measuring unit and the quantity (e.g. liters of milk (crude or processed) / year, hl of beer/year...</i>
annual turnover per product	M€/year					



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Energy consumption

Fuel consumption and cost		1	2	3	4	5	6	
Fuels used	-							
unit								If possible, provide the monthly data in separate sheet and/or the fuel bills. Specify the energy equivalent in base of LCV (lower calorific value)
annual consumption	units/year							
	MWh / year (LCV)							
fuel price	€/kWh LCV							Specify expenditures without VAT
annual energy cost	€/year							Total cost

Electricity consumption and cost								
Tariff		Peak	Standard	Valley	TOTAL	self-generation (co-generation)	sales to grid (co-generation)	
annual consumption	MWh / year							If possible, provide the monthly data in separate sheet and/or the electricity bills
contracted power	kW							
tariff type / class	-							Specify expenditures without VAT
tariff on installed power	€/kWmonth							
tariff on consumption	€/MWh							
annual electricity cost	€/year							Fixed cost of supply
								Cost of consumption excluding fixed costs
								Total cost / total sales (incl. bonus)
Electric consumption according type of use	MWh / year	Electricity for thermal uses			Electricity for non-thermal uses			If there are other uses, specify them in a separate sheet
		Refrigeration	Air Conditioning	Other uses	Motors and machines	Electro-chemicals	Lightning	

Energy consumption by product/service		Product 1	Product 2	Product 3	Other products	Auxiliary services		%	
Fuel consumption	MWh / year (LCV)						Percentage of energy cost on overall production cost:		If possible, specify the energy consumption of the different production lines
Electricity consumption	MWh / year								



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Process data

Processes description			1	2	3	
process short name	-					Give an organizational diagram of the production process (e.g. the flux of crude milk in cheese production or the flux of car chassis in the automobile industry)
process type	continuous / batch					Give a brief description of the process or the unitary operation, and specify if it is continuous or batch
unit operation type	-					
product or process medium (water, oil, air, ...)	-					The medium that is in direct contact with the treated product, e.g. air for drying, lye or water for washing, etc...
typical (final) temperature of the process medium during operation	°C					Give the temperature of the process medium and not that of the heat supplying medium.
inlet temperature of the process medium (before heat recovery)	°C					Inlet temperature of the process medium before heat recovery
start-up temperature of process medium (after breaks)	°C					Temperature of the process equipment before heating up when process start-up begins
daily inflow of process medium	m³					Continuous process: Fluid flow rate times hours of circulation. Batch process with fluid renewal: volume times No. of lots.
volume of the process medium within the equipment or storage	m³					e.g. volume of liquid in a bottle for cleaning
Power requirement of the process in operation	kW					Power requirement during operation at steady state (thermal losses, evaporation, endogenous chemical reactions; without heating of circulating fluid)

Waste heat recovery for this process						
Exists heat from heat recovery for the process ?	(yes/no)					If affirmative, give some brief description of the heat recovery system
source of waste heat	-					Specify the heat source (e.g. heat loss from process X, flue gases from boiler Y, etc)
inlet temperature of the process medium (after heat recovery)	°C					Inlet temperature (towards the system) of the process medium after the heat recovery

Waste heat (available for heat recovery)							notes
medium of outgoing waste heat flows	-						Specify media of waste heat flows (up to 3)
temperature of outgoing (waste) heat flows	°C						Temperature of the outgoing waste heat flow (e.g. water or hot humid air at the outlet of a drying process)
specific enthalpy of outgoing (waste) heat flows	°C						Enthalpy of the outgoing waste heat flow (e.g. water or hot humid air at the outlet of a drying process)
final temperature of outgoing (waste) heat flows	°C						Minimum temperature to which the waste heat flow can be cooled. If there is no limit specify 0
daily outflow of process medium	m³						Can be different from the incoming flow if e.g. there is evaporation or some chemical reaction.
can heat be recovered from the outflowing medium ?	(yes/no)						If NO, specify why: e.g. contamination with substances which can affect the heat exchanger...

Q3_ Processes

Schedule					
hours of process operation per day	h/day				
number of batches per day	-				
duration of 1 batch	h				
days of process operation per year	days / year				

For batch processes: specify the total duration of process, e.g. 3 batches/day x 2 hrs/batch = 6 hrs. If possible, specify daily program.

Data of existing Heat/Cold supply to the process			notes			
Medium supplying heat or cold to the process (water, steam, air)	-					Medium supplying heat or cold to the process (up to 3)
heat or cold supply to the process from distribution line / branch No.	-					Specify the distribution(supply) line of heat/cold feeding the process, using the nomenclature of the hydraulic scheme
temperature of the incoming medium supplying heat or cold to the process/heat exchanger	°C					Temperature of the supplying medium at heat exchanger's inlet
flow rate of the heat supply medium (close to process)	m³/h					Mass flow of the heat/cold supplyind medium
Annual consumption of UPH	MWh / year					Only for the process



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Process data
annex: time schedules

3A

industry audit

Continuous / batch		1	2	3	4	5	
hours of process operation	h/day						<i>total hours of operation per day</i>
please tick weekdays							<i>check (X) the days the process is operating</i>
Monday							
Tuesday							
Wednesday							
Thursday							
Friday							
Saturday							
Sunday							
please indicate time table(s)							<i>Indicate the start and stop time for each process operation during a typical day</i>
start time 1							
end time 1							
start time 2							
end time 2							
number of batches per day	-						
duration of 1 batch	h						<i>Indicate the duration of each batch</i>
start-up	min						<i>Indicate the start-up time for a batch to reach the process temperature</i>
continuous process	min						<i>Duration of a process when process temperature is reached</i>
days of process operation per year	days / year						<i>Total days of operation per year</i>

Equipment for heat and cold generation							General notes: 1) If there are equipment units of the same type and they supply heat or cold to the same distribution line, they should be entered as a single column. The data for single unit is entered, and the number of the units of the same type is indicated. 2) Equipment units of the same type, but supplying heat or cold to different distribution lines should be entered in different columns.
Descriptive data		1	2	3	4	5	
Short name of equipment	-						Give some brief name of the equipments to identify them in the reports
Manufacturer	-						Attach the technical data if available
Year of manufacturing or/and installation?	-						Year of manufacturing or installation
Model	-						Model according manufacturer nomenclature
Type of equipment	-						e.g. boiler / burner / chiller / compressor / CHP motor
Number of units of the same type	-						Specify how many units of this type exist

Technical data							
Nominal power (heat or cold, output)	kW						Power at manufacturer nominal conditions
Fuel type	-						Select fuel type from predefined list
Fuel consumption (nominal)	-						Specify the units below
Units (fuel consumption)	-						Specify units for the nominal fuel consumption, e.g. m3/h, l/h, kg/h
Electrical power input	kW						Electrical power, incl. auxiliary components, such as water pumps, control,...
Mean overall thermal conversion efficiency	-						Specify the efficiency of boiler or EER(COP) for cold generation
Mean utilisation factor (full capacity = 100%)	-						Specify the mean supplied power of the boiler/cooler/etc... with respect to its nominal power
<i>Boilers only:</i>							
Temperature of exhaust gas at standard operation conditions	°C						Only for boilers and CHP
Excess air ratio	-						Only for boilers and CHP
<i>CHP only</i>							
Electricity production	-						Only for CHP motors
Electrical conversion efficiency	-						Only for CHP motors

Q4H_HeatGeneration

Heat source / sink							
Heat or cold supplied to the distribution line / branch (piping or duct) no.	-						Specify the tube for supply to the equipment, using the nomenclature of the block "distribution system" If waste heat is used, indicate the process or equipment from which waste heat originates Temperature of the medium entering the evaporator Power applied to the generator of a thermal heat pump Temperature of heat supply fluid entering the generator Indicate if the circuit of the heat supply to generator is closed or opened (waste heat released to ambient) Refrigerant or working fluid
<i>Heat pumps only:</i>							
Low temperature heat source	-						
Temperature of heat source	°C						
Thermal power input (thermal heat pumps only)	kW						
Driving temperature (thermal heat pumps only)	°C						
Origin of high temperature heat source (thermal heat pumps only)	-						
Refrigerant	-						

Schedule							
Hours of operation per day	h/day						Specify representative mean values
Days of operation per year	days / year						Specify representative mean values

Equipment for heat and cold generation							<p>General notes: 1) If there are equipment units of the same type and they supply heat or cold to the same distribution line, they should be entered as a single column. The data for single unit is entered, and the number of the units of the same type is indicated. 2) Equipment units of the same type, but supplying heat or cold to different distribution lines should be entered in different columns.</p>
		1	2	3	4	5	
Descriptive data							
Short name of equipment	-						Give some brief name of the equipments to identify them in the reports
Manufacturer	-						Attach the technical data if available
Year of manufacturing or/and installation?	-						Year of manufacturing or installation
Model	-						Model according manufacturer nomenclature
Type of equipment	-						e.g. boiler / burner / chiller / compressor / CHP motor
Number of units of the same type	-						Specify how many units of this type exist

Technical data							
Nominal power (heat or cold, output)	kW						Power at manufacturer nominal conditions
Refrigerant	-						Refrigerant or working fluid
Electrical power input	kW						Electrical power, incl. auxiliary components, such as water pumps, control,...
Mean overall thermal conversion efficiency	-						Specify the efficiency of boiler or EER(COP) for cold generation
Mean utilisation factor (full capacity = 100%)	-						Specify the mean supplied power of the boiler/cooler/etc... with respect to its nominal power
<i>Thermal chillers only</i>							
Fuel consumption (nominal)	-						Specify the units below
Units (fuel consumption)	-						Units (fuel consumption)

Q4C_ColdGeneration

Heat source / sink							
Heat or cold supplied to the distribution line / branch (piping or duct) no.	-						Specify the tube for supply to the equipment, using the nomenclature of the block "distribution system" If applies, specify heat exchanger where waste heat is used Outlet temperature of cooling water or hot air stream Power applied to the generator of a thermal chiller Temperature of heat supply fluid entering the generator Indicate if the circuit of the heat supply to generator is closed or opened (waste heat released to ambient)
<i>Chillers only</i>							
Destination of waste heat	-						
Temperature of re-cooling	°C						
Thermal power input (thermal chillers only)	kW						
Driving temperature (thermal chillers only)	°C						
Origin of high temperature heat source (thermal chillers only)	-						

Schedule							
Hours of operation per day	h/day						Specify representative mean values
Days of operation per year	days / year						Specify representative mean values

Distribution of heat/cold		1	2	3	4	5	
name of the branch / distribution system	-						Attach a simplified scheme of the hydraulic system of processing and distribution of heat/cold
heat or cold distribution medium	-						Give some brief name or number of the distribution tube consistent with the hydraulic scheme
nominal production or circulation rate (specify units)	m ³ /h kg/h						e.g air for drying process, vapour, hot water, refrigerant,....
outlet temperature (to distribution)	°C						Temperature of supply medium from equipment
return temperature (from distribution)	°C						Temperature of return of the supply medium from distribution (return temperature of condensate in a vapour system)
Percentage of recirculation	%						Specify the percentage of recirculation of the heat/cold supply medium (100% = totally closed circuit)
feed-up in open circuit	°C						Temperature of medium of distribution of heat/cold entering in open circuit (e.g. temperature of water entering from network....)
pressure of heat or cold distribution medium	bar						Working pressure for the heat/cold supply medium
total length of distribution piping or ducts (one way)	m						Only distance one way
total coefficient of heat losses for piping or ducts	kW/K						For the whole duct: go and return
mean pipe diameter	mm						
insulation thickness	mm						

Storage		1	2	3	4	5	
number of the storage units	-						Specify the number of storage units of the same type
volume of the storage	m ³						Volume of the storage medium of a single storage unit
type of heat storage	-						Select from predefined list
pressure of heat storage medium	bar						Pressure of the process medium entering the storage unit if different from storage medium
maximum temperature of the storage	°C						The maximum temperature to which storage unit can be operated



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Heat recovery

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Heat exchanger no.		1	2	3	4	5	
Short name of heat exchanger	-						Give a short name of the equipment
Heat exchanger type	-						Specify the type of heat exchanger, e.g. shell-and-tube, plate, fin-and-tube, ...
Heat transfer rate	kW						Heat transfer rate for the specific working conditions
Log. Mean Temperature Diff. (LMTD)	K						Between the fluids in the heat exchanger
Total heat transfered	MWh						Heat transferred for year
Heat source (process [+outflow no.], equipment, ...)	-						Indicate: Process, Equipment, Distribution line, Compressor, Electric motor, together with its number
Inlet temperature (source)	°C						Inlet temperature of the hot fluid
Inlet specific enthalpy (source)	kJ/kg						Inlet enthalpy of the hot fluid
Outlet temperature (source)	°C						Outlet temperature of hot fluid
Outlet specific enthalpy (source)	kJ/kg						Outlet enthalpy of the hot fluid
Heat sink (process, pipe/duct)	-						Indicate: Process or Distribution line and number. If heat exchange is via storage, it should be defined in the distribution line
Inlet temperature (sink)	°C						Inlet temperature of the cold fluid
Outlet temperature (sink)	°C						Inlet enthalpy of the cold fluid

Q5b_HeatRecovery

waste heat from electrical equipment		1	2	3	4	5	
Short name of electrical equipment	-						Give a short name of the equipment
Equipment type	-						specify type of equipment, e.g. compressor, electric motor,...
Waste heat type	-						specify type of waste heat (e.g. Recooling of compressed air, cooling water of motor/compressor, ...)
Available waste heat	kW						estimated quantity
Medium	-						Waste heat carrying medium (fluid)
Flow rate	kg/h						Specify the flow rate of the waste heat carrying medium
waste heat temperature	°C						Specify the temperature of the waste heat medium at the outlet
present use of waste heat	yes/no						If yes, specify distribution pipe / duct or heat exchanger where waste heat is used at present

Schedule							
hours of operation per day	h/day						Indicate the operation schedule of the waste heat producing equipment.
number of batches per day	-						
duration of 1 batch	h						
days of process operation per year	days / year						



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Renewable energies

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Main motivation for renewable energy use

Are you interested in the use of renewable energy? (solar thermal/biomass)	yes/no	<input type="text"/>	possibility of saving fuel cost	yes/no	<input type="text"/>
			contribution to a more ecologic energy supply	yes/no	<input type="text"/>
			using solar energy helps for a better marketing of your products	yes/no	<input type="text"/>
			others:	<input type="text"/>	

Solar thermal energy

Latitude of the site	°	<input type="text"/>	<i>Insert the latitude in degree only. E.g. Rome's latitude is 41,90°</i>				
Annual radiation on tilted surface (total)	kWh/m ² .a	<input type="text"/>	<i>Annual average solar specific radiation on the horizontal</i>				
			1	2	3	4	
Short name of the available area	-	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<i>Define a short name for each surface area available for installation in order to clearly identify them</i>
Availabe roof, ground, wall area	m ²	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<i>If there are different surfaces available, give the measure of each surface area</i>
Positioning of the surface	Inclination (°)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<i>Give the surface inclination with respect to the horizontal (i.e. tilt angle, in degrees only)</i>
	Orientation	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	
Shading problems?	-	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<i>Consider shadows due to buildings, trees, etc.; all over the year, in winter time or in early morning/late afternoon</i>
Distance between the roof, ground, wall area(s) and the technical room or process	m	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<i>Estimate the piping lenght (single way) from the roof, ground,wall area to the technical room or to the process</i>
<i>Roofs only:</i>							<i>Specify the type of roof, e.g. composite sandwich panels, etc...</i>
Type of roof	-	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	
Static load capacity of the roof(s)	kg/m ²	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<i>The additional weight of a solar collector field is about 25-30 kg/m²</i>
Is a plant/drawing of building(s) and surface(s) available?	yes/no	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<i>Enclose the plant of the building(s) and/or a drawing of the surface(s)</i>

Biomass			
Availability of biomass from the processes		Availability of biomass from the region	
Type of biomass available from processes	-		
Period of year the biomass is available	dd/mm-dd/mm		<i>Specify if the availability is continuous or during some specific season of the year</i>
Number of days biomass is produced	days		
Daily quantity of biomass	t/day		
Space availability to stock biomass?	m3		<i>Specify the volume</i>
LCV biomass	kWh/kg		
Humidity	%		
Type of biomass available	-		
Unit price of biomass	€/t		
Period of year the biomass is available	dd/mm-dd/mm		<i>Specify if the availability is continuous or during some specific season of the year</i>
Number of days the biomass is produced	days		



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Buildings

Building (or part of building)		1	2	3	4	5	Attach a brief description/plan of the building
Building short name							Give some brief name of the buildings to identify them in the reports
Constructed surface	m2						Surface limited by building's perimeter multiplied by number of floors
Useful surface	m2						Total useful surface of building (excluding walls)
Use of the building							Specify use, e.g. offices, production, storage,...
<i>Global data on energy demand</i>							
Maximum heating power	kW						Maximum heating power (without including the security coefficient of the equipment)
Maximum cooling power	kW						
Annual heating demand	MWh / year						Thermal demand (useful heat and cold). Indicate MONTHLY data in a separate table (if available)
Annual demand of air conditioning	MWh / year						
Daily consumption of DHW	l/day						Only consumption of hot water that is not included yet in "Processes"
Hours of occupation	h/day						Occupational period of the building
Days of use per year	days/year						
Holidays period	dd/mm-dd/mm						Period of year that the building is not used
Heating period	dd/mm-dd/mm						
Air conditioning period	dd/mm-dd/mm						Indicate period, e.g. October - February



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Economic parameters

Economic parameters used in the economic analysis and the comparative analysis of possible alternatives					
General inflation rate	%		Specify the rate of prices variation estimated for the useful life of the installations (e.g. in the next 15-20 years)	Public funding for energy saving measures:	Type (credit, subvention)
Rate of increment of energy prices	%				
Nominal rate of interest for external financing of installations	%		Percentage of the external financing for the inversions		
Percentage of external financing for installations	%				
Time for economic amortisation of installations	years				

Operation and maintenance costs				
	Total cost	Own personnel	External personnel	Spare parts and fungible assets
	€/year	€/year	€/year	€/year
General maintenance				
Buildings				
Machines and equipment for processes				
Generation and distribution of heat and cold				
Total				

Externalisation of energetic services		
Is there any energy management system implemented?	yes/no	
Is the energy management externalized?	yes/no	