ENER/FP7/296003/EFENIS

Project full title:	**Efficient Energy Integrated Solutions for Manufacturing Industries**
Project Acronym:	**EFENIS**
Deliverable no.:	**D6.1**
Title of the deliverable:	**Consistent data sets (base case) for further analysis**
Contractual Date of Delivery to the CEC:	**Month 8**
Actual Date of Delivery to the CEC:	**Month 9**
Organisation name of lead contractor for this deliverable:	**MOL**
Author(s):	**Gábor Kis, Klara Kubovicsne, Jiri Klemes, Petar Varbanov, Robin Smith, Li Sun, Ning Jiang, Igor Bulatov**
Participants(s):	**P3, P1, P10**
Work package contributing to the deliverable:	**WP6**
Nature:	**OTHER**
Version:	**1**
Total number of pages:	**22**
Start date of project:	**1st August 2012**
Duration:	**36 months**

Project co-funded by the European Commission within the Seventh Framework Programme (2007-2013)

Dissemination Level

PU	Public
PP	Restricted to other programme participants (including the Commission Services)
RE	**Restricted X**
CO	Confidential, only for members of the consortium (including the Commission Services)

Abstract:
The dataset for the existing utility system at MOL refinery

1. Utility System Configuration 1'!A1

(a) Steam Mains
(b) Steam System Flow Diagram
(c) Deaerator Data
(d) Condensate Return Data
(e) Demineralised Water Cost

2.Process Steam Use and Generation 2'!A1

(a) Steam Used by Processes
(b) Steam Generated by Processes to Steam

3. Steam Boiler Data 3'!A1

(a) Boiler Fuel Data
(b) Boiler Capacity and Firing
(c) Boiler Efficiency

4. Gas Turbines

(a) Gas Turbine Fuel Data
(b) Gas Turbine Efficiency

5. Gas Turbine Heat Recovery Steam Generator (HRSG) Data 4'!A1

(a) HRSG Fuel Data for Supplementary Firing
(b) HRSG Capacity and Firing
(c) HRSG Efficiency

6. Steam Turbine Turbogenerators 5'!A1

(a) Steam Turbine Constraints
(b) Steam Turbine Efficiency

7. Steam Turbine Direct Drives (Turbines > 500kW) 6'!A1

(a) Steam Turbine Conditions

8. Electricity Data 7'!A1

(a) For Each Electricity Tariff

1. Utility System Configuration

(a) Steam Mains: Pressure and temperature of each steam main.

STEAM MAIN	Pressure (barg)	Temperature (°C)
	2012 average	2012 average
VHP		
HP		
MP		
LP		
VLP		

(b) Steam System Flow Diagram: Develop a flowsheet of the steam system showing the connectivity of the steam boilers, gas turbines, heat recovery steam generators, deaerators, steam mains, back pressure turbines, condensing turbines, letdown stations, desuperheaters and flash steam recovery.

(c) Deaerator Data: Deaerator pressure and flows (if known) to

			Condensate Return		Treated Water	
DEAERATOR	Pressure (barg)	Steam (t/h)	Temperatur (°C)	Flowrate (t/h)	Temperatur (°C)	Flowrate (t/h)
	2012 average	2012 average	2012 average	2012 average	2012 average	2012 average

(d) Condensate Return Data: Percent condensate return. For percent condensate return, the basis needs to be clear (either based on steam generated from the boilers, or steam delivered to the processes). Condensate return based on steam generated from the boilers (preferred) can be determined by a mass balance in a species in the incoming treated water.

Condensate Return (%)	

(e) Demineralised Water Cost: Cost of incoming treated water.

Demineralized Water Cost ($/t)	

2. Process Steam Use and Generation

(a) Steam Used by Processes: The mass flow rates (kg/h) of steam used at the various levels from the site mains (lump together small flows).

PROCESS	HP Usage (t/h)		MP Usage (t/h)		LP Usage (t/h)	
	2012 average	2012 work days	2012 average	2012 work days	2012 average	2012 work days

(b) Steam Generated by Processes to Steam Mains: For steam production in processes fed to the steam mains, record the mass flow rates and steam conditions (lump together small flowws).

PROCESS	HP Steam Generation					
	Flowrate (t/h)		**Pressure** (bara)		**Temperature** (°C)	
	2012 average	2012 work days	2012 average	2012 work days	2012 average	2012 work days

PROCESS	MP Steam Generation					
	Flowrate (t/h)		**Pressure** (bara)		**Temperature** (°C)	
	2012 average	2012 work days	2012 average	2012 work days	2012 average	2012 work days

PROCESS	LP Steam Generation					
	Flowrate (t/h)		**Pressure** (barg)		**Temperature** (°C)	
	2012 average	2012 work days	2012 average	2012 work days	2012 average	2012 work days

3. Steam Boiler Data

(a) Boiler Fuel Data : Heating value (net heating value ultimately needed) and cost of boiler fuels.

Fuel Type	**Fuel Gas**	**Fuel Oil**	**Solid Fuel**
	2012 average	2012 average	2012 average
Heating Value (kJ/m^3 or kJ/kg for solid fuel)			
Net Heating Value (kJ/m^3 or kJ/kg for solid fuel)			
Cost ($\$/m^3$ or $/kg for solid fuel)			

(b) Boiler Capacity and Firing: Boilers maximum and minimum steam capacity and firing

BOILER	Steam		Fuel Gas		Fuel Oil		Solid Fuel	
	Minimum (t/h)	**Maximum** (t/h)	**Minimum** (t/h)	**Maximum** (t/h)	**Minimum** (t/h)	**Maximum** (t/h)	**Minimum** (t/h)	**Maximum** (t/h)
	2012 average	2012 average	2012 average	2012 average	2012 average	2012 average	2012 average	2012 average

(c) Boiler Efficiency: For each boiler, operating data to correlate boiler efficiency with

BOILER:															
Fuel						Boiler Feedwater				Steam					
Fuel Gas (Nm^3/h)		Fuel Oil (m^3/h)		Solid Fuel (kg/h)		Temperature (^oC)		Flowrate (t/h)		Pressure (bara)		Temperature (^oC)		Flowrate (t/h)	
2012 average		2012 average		2012 average		2012 average		2012 average		2012 average		2012 average		2012 average	
1250						106		14		42.2		426		13.72	
1487						106		17.6		42.2		426		17.25	

4. Gas Turbines

(a) Gas Turbine Fuel Data: Heating value (net heating value ultimately needed) and cost of gas turbine fuels.

Fuel Type	**Fuel Gas**		**Fuel Oil**	
	2012 average		2012 average	
Gross Heating Value (kJ/m^3 or kJ/kg for solid fuel)				
Net Heating Value (kJ/m^3 or kJ/kg for solid fuel)				
Cost ($\$/m^3$ or $/kg for solid fuel)				

(b) Gas Turbine Efficiency: Performance data for gas turbines. For each turbine, inlet air conditions, steam injection (if used), fuel combustion and power generated for a number of operating points (*duplicate tables are available at the end of the report*).

GAS TURBINE MANUFACTURER:
MODEL

Fuel				**Steam Injection**						**Ambient Temperature**		**Power**	
Fuel Gas (Nm^3/s)		**Fuel Oil** (m^3/s)		**Pressure** (bara)		**Temperature** (^oC)		**Mass Flowrate** (t/h)		(^oC)		(MW)	
2012 average		2012 average		2012 average		2012 average		2012 average		2012 average		2012 average	

5. Gas Turbine Heat Recovery Steam Generator (HRSG) Data

(a) HRSG Fuel Data for Supplementary Firing: Heating value of HRSG fuels.

Fuel Type	**Fuel Gas** (kJ/m^3)		**Fuel Oil** (kJ/m^3)	
	2012 average		2012 average	
Gross Heating Value				
Net Heating Value				

(b) HRSG Capacity and Firing: HRSG maximum and minimum steam capacity and firing.

HRSG	Steam Capacity				Fuel Gas				Fuel Oil			
	Minimum		Maximum		Minimum		Maximum		Minimum		Maximum	
	2012 average		2012 average		2012 average		2012 average		2012 average		2012 average	

(c) HRSG Efficiency: For each HRSG, operating data to correlate boiler efficiency with capacity. At east 5 or 6 data points are required at

HRSG:													
Fuel				**Boiler Feedwater**				**Steam**					
Fuel Gas (Nm^3/h)		**Fuel Oil** (m^3/h)		**Temperature** (^oC)		**Flowrate** (t/h)		**Pressure** (bara)		**Temperature** (^oC)		**Flowrate** (t/h)	
2012 average		2012 average		2012 average		2012 average		2012 average		2012 average		2012 average	

6. Steam Turbine Turbogenerators

(a) Steam Turbine Constraints: Maximum and minimum flows for each turbine stage.

STEAM TURBINE :								
	Stage 1		**Stage 2**		**Stage 3**		**Stage 4**	
	2012 average		2012 average		2012 average		2012 average	
Maximum Inlet Flowrate (t/h)								
Minimum Inlet Flowrate (t/h)								

(b) Steam Turbine Efficiency: Performance data for steam turbine turbogenerators. For each turbine, inlet steam flow and conditions, outlet steam conditions and power generated for at least 10 operating points (*duplicate tables are available at the end of the report*).

STEAM TURBINE :										
Power (MW)	**Mass flowrate (t/h)**									
	Inlet		**Stage 1 Exit**		**Stage 2 Exit**		**Stage 3 Exit**		**Stage 4 Exit**	
	2012 average		2012 average		2012 average		2012 average		2012 average	

STEAM TURBINE :										
Power (MW)	**Pressure (bara)**									
	Inlet		**Stage 1**		**Stage 2**		**Stage 3**		**Stage 4**	
			Exit		**Exit**		**Exit**		**Exit**	
	2012 average		2012 average		2012 average		2012 average		2012 average	
1.025										
0.85										
0.56										
0.63										
2.1										
1.7										
1.5										
1.75										
1.35										
1.17										

STEAM TURBINE :										
Power (MW)	**Temperature (°C)**									
	Inlet		**Stage 1**		**Stage 2**		**Stage 3**		**Stage 4**	
			Exit		**Exit**		**Exit**		**Exit**	
	2012 average		2012 average		2012 average		2012 average		2012 average	
1.025										
0.85										
0.56										
0.63										
2.1										
1.7										
1.5										
1.75										
1.35										
1.17										

7. Steam Turbine Direct Drives (Turbines > 500kW)

(a) Steam Turbine Conditions: Power, flowrates, temperatures and pressures for steam turbine direct drives.

STEAM TURBINE	Power (MW)		Steam Flowrate (t/h)		Inlet Steam				Outlet Steam				Drive Switch to Electric Motor (Yes/No)
					Pressure (bara)		Temperature (oC)		Pressure (bara)		Temperature (oC)		
	2012 average		2012 average		2012 average		2012 average		2012 average		2012 average		

8. Electricity Data

(a) For Each Electricity Tariff: Constraints and costs for electricity tariffs. Electricity demand includes any power demand that can only be satisfied with electricity e.g. lighting, electric motors, etc (*duplicate tables are available at the end of the report*).

TARIFF:		
Total Site Electricity Demand (MWh)		
Import Electricity	Minimum (MWh)	
	Maximum (MWh)	
Export Electricity	Minimum (MWh)	
	Maximum (MWh)	
Electricity Cost	Import ($/MWh)	
	Export ($/MWh)	
Standing Charges for Import/Export ($/y)		