

The Umberto Software for environmental innovations

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Who is ifu Hamburg

- Software Development and Consulting
- Founded 1992, today 33 employees
- 50 countries, 3000 clients
- Market leader in software for material and energy flow visualization and modelling



Software developed by ifu Hamburg

- **Umberto** – *know the flow.*
Material and Energy Flow Management
- **e!Sankey** – *show the flow.*
Vizualisation of Sankey Diagrams
- **ecoinvent**
Database for LCA DATA
(Sales- and Technology Partner)
- **Empinia** – *the plugin architecture.*
Open Source Software Platform for .Net



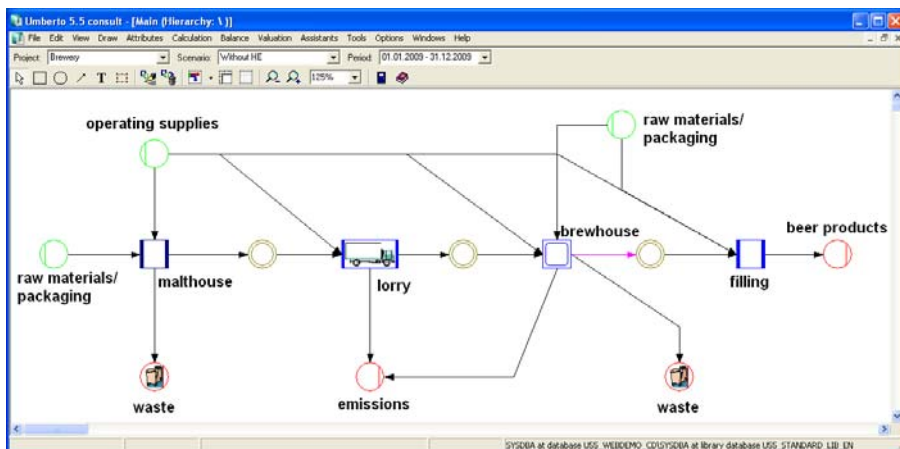
Selected References



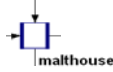
Modelling of Process Systems with Umberto

- Material and energy flow analysis through graphical modelling and visualization

Process modelling



Process specification



Transition Specifications T1 - Input/Output Relations

Var	Place	Material	Coefficient	B. Unit	DQ	Var	Place	Material	Coefficient	B. Unit	DQ
X00	P1	▲ barley	1.30	kg	●	Y00	P2	▲ brewing malt	1.00	kg	●
X01	P3	▲ electric energy	98.00	kJ	●	Y01	P4	▲ waste, unspecified	5.30	kg	●
X02	P3	▲ heat energy	22.00	kJ	●						
X03	P1	▲ drinking water	5.00	kg	●						

Process specification



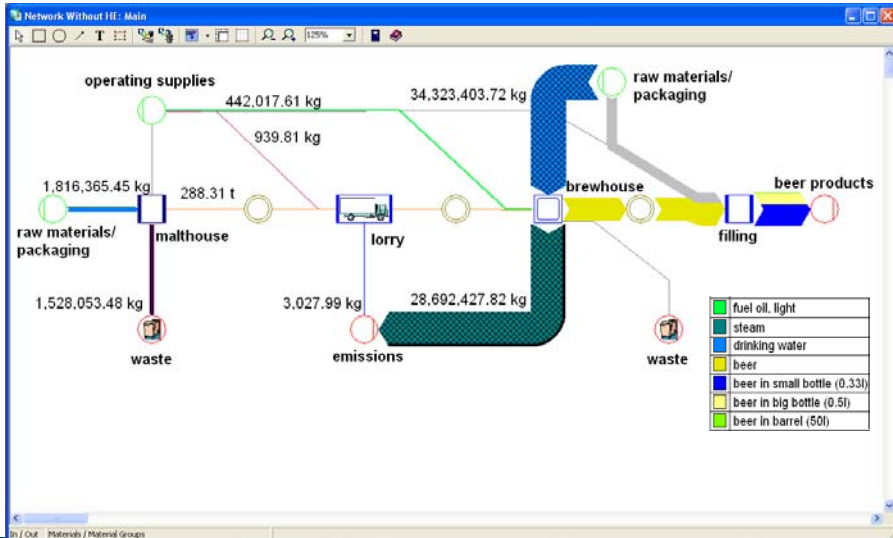
Transition Specifications T4 - User Defined Functions

Var	Place	Material	B. Unit	DQ	Var	Place	Material	B. Unit	DQ
X00	P1	▲ bottle (0,33l)	kg	●	Y00	P7	▲ beer in small bottle (0,33l)	kg	●
X01	P1	▲ bottle (0,5l)	kg	●	Y01	P7	▲ beer in big bottle (0,5l)	kg	●
X02	P1	▲ barrel (50l)	kg	●	Y02	P7	▲ beer in barrel (50l)	kg	●
X03	P8	▲ beer	kg	●					
X04	P3	▲ electric energy	kJ	●					

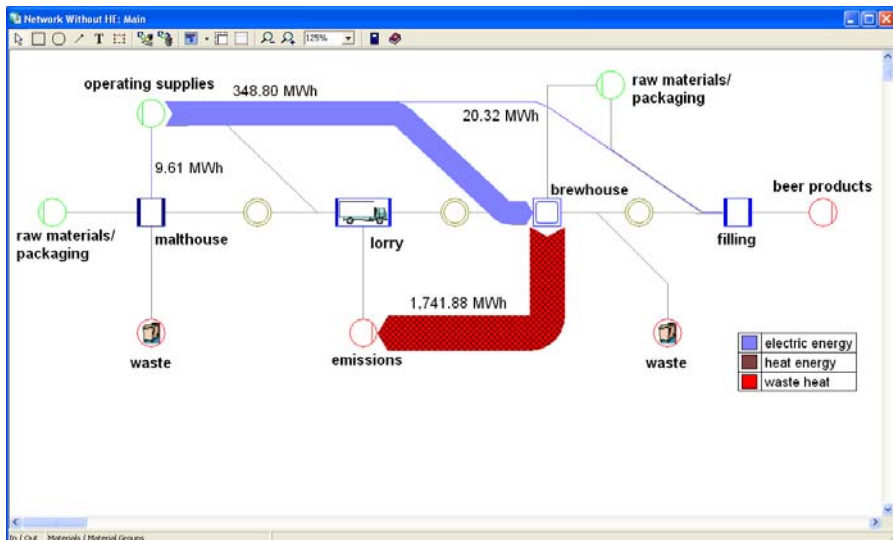
Transition Specifications T4 - User Defined Functions

Var	Name	Quantity	Unit	DQ	Description
BARR	● Share of beer in barrels (50l)	5.00	%	●	
BB	● Share of beer in big bottles (0,5l)	35.00	%	●	
SB	● Share of beer in small bottles (0,33l)	60.00	%	●	

Material flow visualization



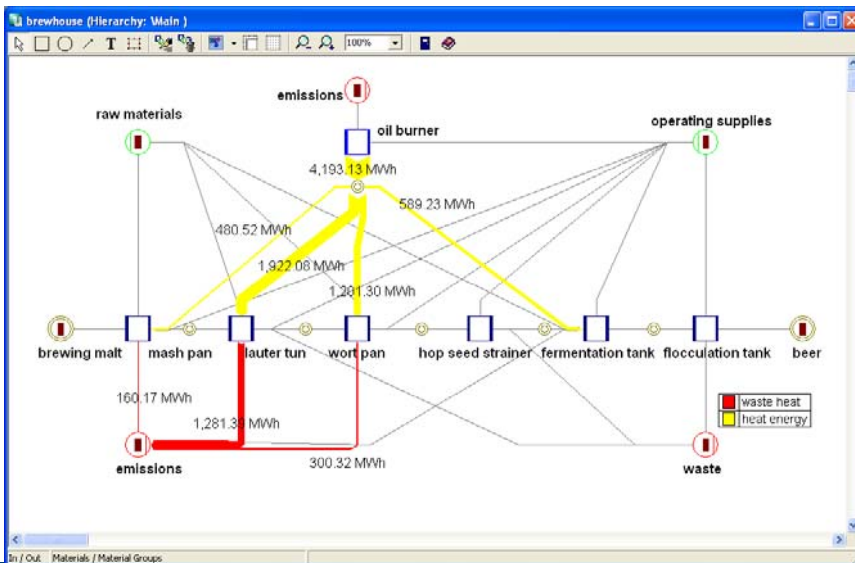
Energy flow visualization



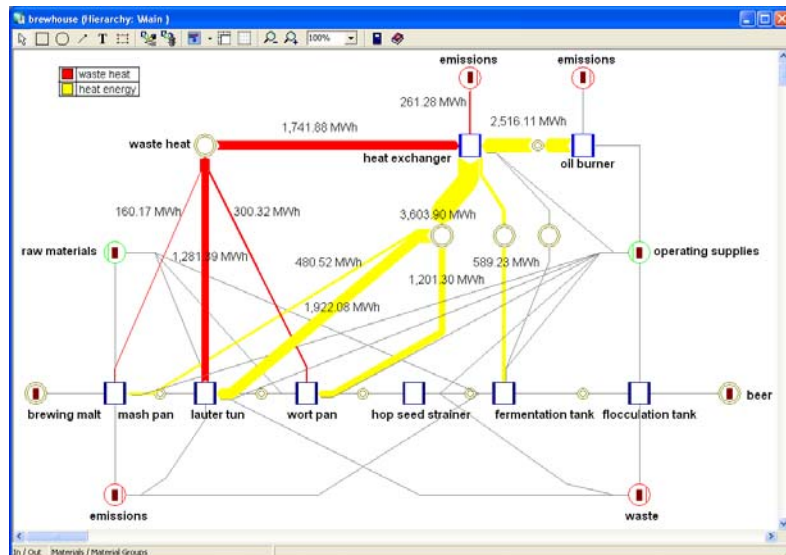
Modelling of Process Systems with Umberto

- Material and energy flow analysis through graphical modelling and visualization
- Planning tool to optimize production systems

Present Situation



Planning of Process Alternatives



Modelling of Process Systems with Umberto

- Material and energy flow analysis through graphical modelling and visualization
- Planning tool to optimize production systems
- **Energy and mass balancing**

Balance Sheet

Materials

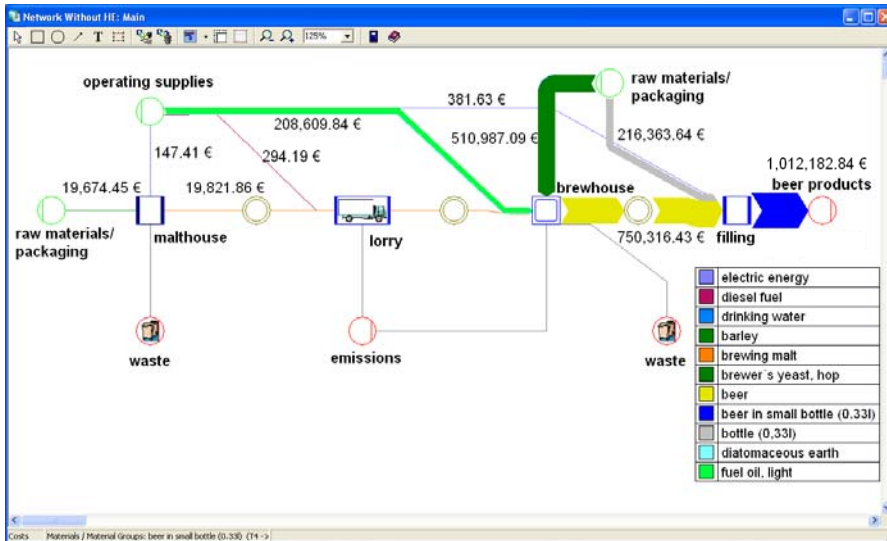
Input/Output | Stocks | Selected Elements | Parameters | Information | General

Input:			Output:		
Item	Quantity	Unit	Item	Quantity	Unit
▲ electric energy			▲ carbon dioxide, fossil (a)		
Without HE	376.97	MWh	Without HE	1,323,818.68	kg
With HE	402.13	MWh	With HE	795,560.32	kg
▲ Fuel oil, light			▲ carbon monoxide (a)	748.30	kg
Without HE	429,643.87	kg	▲ dinitrogen monoxide (a)	17.75	kg
With HE	257,810.86	kg	▲ fermentation gas	2,842.42	t
▲ heat energy			▲ hydrogen chloride (a)	0.00	kg
Without HE	1.76	MWh	▲ methane (a)	1.82	kg
With HE	1.76	MWh	▲ methylene oxide (a)	0.65	kg
☐ packaging			▲ NMVOC, unspec. (a)	43.74	kg
▲ barrel (50l)			▲ NOx (a)	712.51	kg
Without HE	7,000.00	barrel(s)	▲ particles (a)	44.86	kg
With HE	7,000.00	barrel(s)	▲ particles (small) (a)	3.06	kg
▲ bottle (0,33l)			▲ PCDD, PCDF (a)	0.00	kg
Without HE	12,727,272.73	bottle(s)	▲ steam	51,896,155.79	kg
With HE	12,727,272.73	bottle(s)	▲ sulfur dioxide (a)	2,200.15	kg
▲ bottle (0,5l)			▲ waste heat		
Without HE	4,900,000.00	bottle(s)	Without HE	1,741.88	MWh
With HE	4,900,000.00	bottle(s)	With HE	261.28	MWh
Sum			Sum		
kJ			kJ		
Without HE	1,363,433,598.08	kJ	Without HE	6,270,785,491.56	kJ
With HE	1,454,013,725.02	kJ	With HE	940,617,823.73	kJ
kg			kg		
Without HE	41,161,504.38	kg	Without HE	42,057,086.49	kg
With HE	40,989,671.36	kg	With HE	41,527,906.93	kg

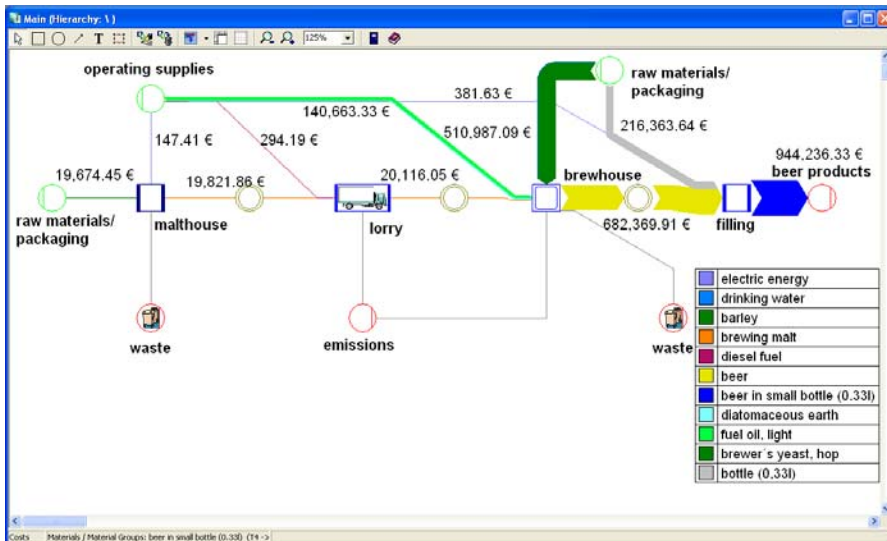
Modelling Process Systems with Umberto

- Material and energy flow analysis through graphical modelling and visualization
- Planning tool to optimize production systems
- Energy and mass balancing
- Causal assignment of expenses

Visualization of Cost Flows: Present Situation

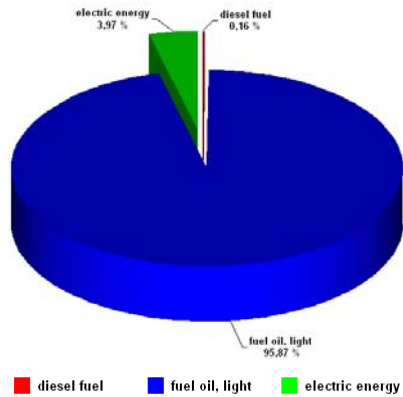


Visualization of Cost Flows: Alternative Planning



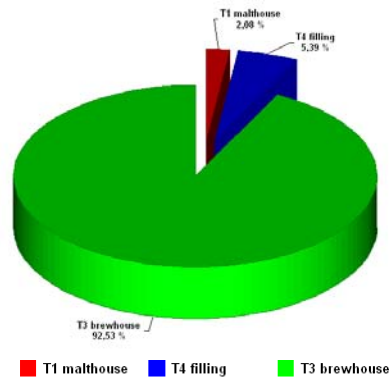
Balance Sheet - Without HE		
Item	Proportional Costs	Unit
Brewery Ltd.		
energy		
▲ diesel fuel	294.19 €	
▲ electric energy	7,080.13 €	
▲ fuel oil, light	171,072.12 €	
packaging		
▲ bottle (0,33l)	216,363.64 €	
raw materials / intermediate products		
▲ barley	18,771.96 €	
▲ brewer 's yeast	354,132.95 €	
▲ diatomaceous earth	30,986.63 €	
▲ drinking water	22,381.95 €	
▲ hop	135,374.68 €	
waste		
▲ 6730 blowwaste	9,693.50 €	
▲ 6730 brewer 's grains	677.55 €	
▲ 6731 diatomaceous earth left-overs	232.40 €	
2 Salaries		
◆ 21 Salaries filling	45,121.14 €	
Sum		
Revenues	5,090,909.09 €	
Variable Costs	-1,012,182.84 €	
Marginal Income	4,078,726.25 €	

Distribution of Energy Costs



Balance Sheet - Without HE		
Item	Proportional Costs	Unit
Brewery Ltd.		
energy		
▲ diesel fuel	294.19 €	
□ T2 lorry, round tr		
▲ electric energy		
□ T1 malthouse	147.41 €	
□ T3 malthouse	6,551.09 €	
□ T4 filling	381.63 €	
▲ fuel oil, light		
□ T3 brewhouse	171,072.12 €	
packaging		
▲ bottle (0,33l)	216,363.64 €	
raw materials / intermediate products		
▲ waste	561,648.17 €	
▲ waste	10,603.45 €	
2 Salaries		
◆ 21 Salaries filling	45,121.14 €	
□ T4 21 filling		
Sum		
Revenues	5,090,909.09 €	
Variable Costs	-1,012,182.84 €	
Marginal Income	4,078,726.25 €	

Electric energy consumption by process



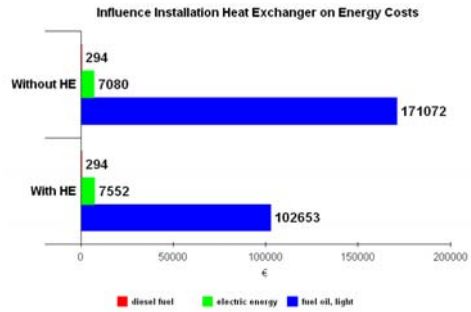
Balance Sheet

Materials - Transitions

Input/Output | Stocks | LCIs | Variable Costs | Fixed Costs | Selected El...

beer in small bottle (0.33) (Output, A16) 12,727,272.73 bottle(s)

Variable Costs:		
Item	Proportional Costs	Unit
Brewery Ltd.		
energy		
▲ diesel fuel	588.38 €	
▲ electric energy		
Without HE		
T1 malthouse	147.41 €	
T3 brewhouse	6,551.09 €	
T4 filling	381.63 €	
With HE		
T1 malthouse	147.41 €	
T3 brewhouse	7,023.66 €	
T4 filling	381.63 €	
▲ fuel oil, light		
Without HE		
T3 brewhouse	171,072.12 €	
With HE		
T3 brewhouse	102,653.04 €	
Sum		
Revenues		
Without HE	5,090,909.09 €	
With HE	5,090,909.09 €	
Variable Costs		
Without HE	-967,061.70 €	
With HE	-899,115.18 €	
Marginal Income		
Without HE	4,123,847.40 €	
With HE	4,191,793.91 €	

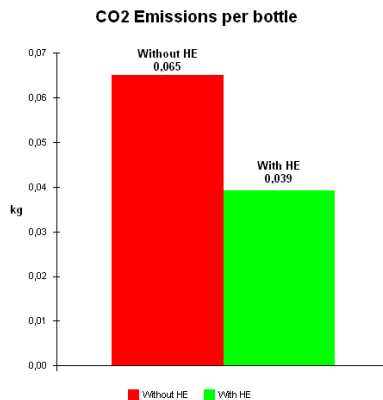


Free defined key performance indicators in Umberto

Valuation System Results (Multi, Imp...)

Valuations

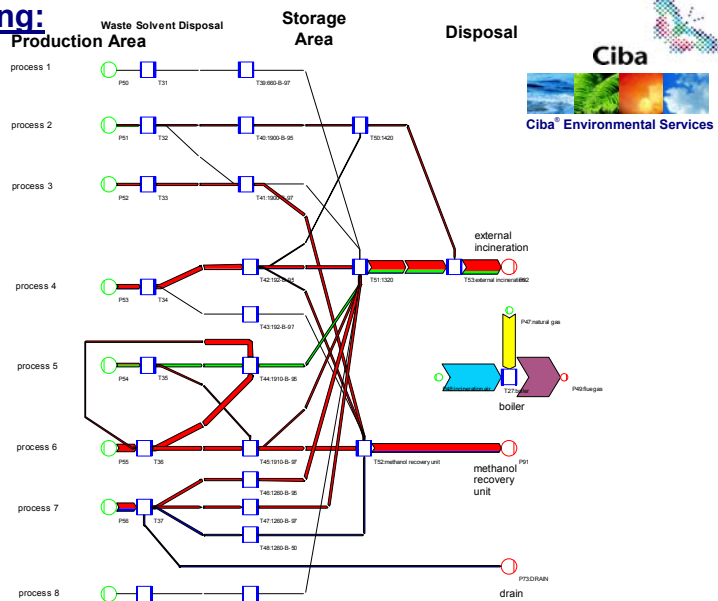
Item	Quantity	Unit
energy consumption per bottle		
Without HE	940.641	kJ/bottle
With HE	595.717	kJ/bottle
water consumption per bottle		
Without HE	1.759	l/bottle
With HE	1.759	l/bottle
waste per bottle		
Without HE	1.569	kg/bottle
With HE	1.543	kg/bottle
waste heat per bottle		
Without HE	308.461	kJ/bottle
With HE	46.269	kJ/bottle
CO2 emissions per bottle		
Without HE	0.065	kg/bottle
With HE	0.039	kg/bottle



Example

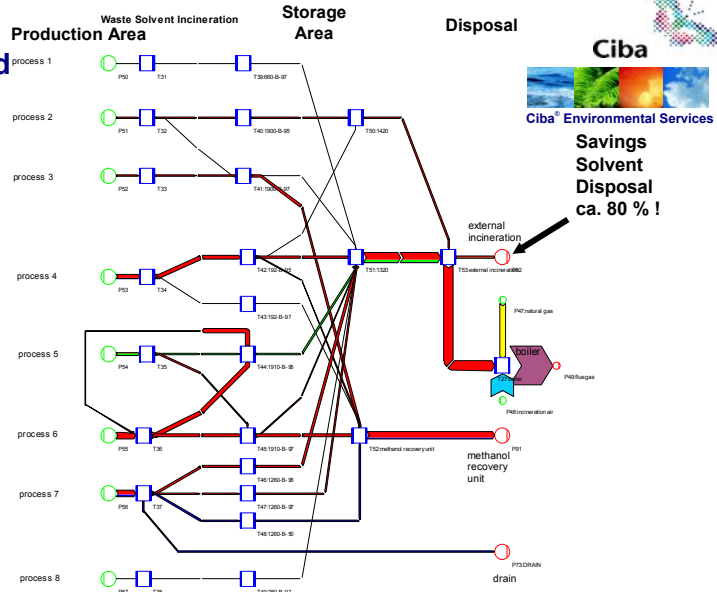
Eco-Engineering: Solvents

Totally approx.
7700 to/y
Liquid
Waste Solvent:
Methanol,
Toluene,
Acetic Acid,
Water,
Ammonia,
Halogenated
Compounds

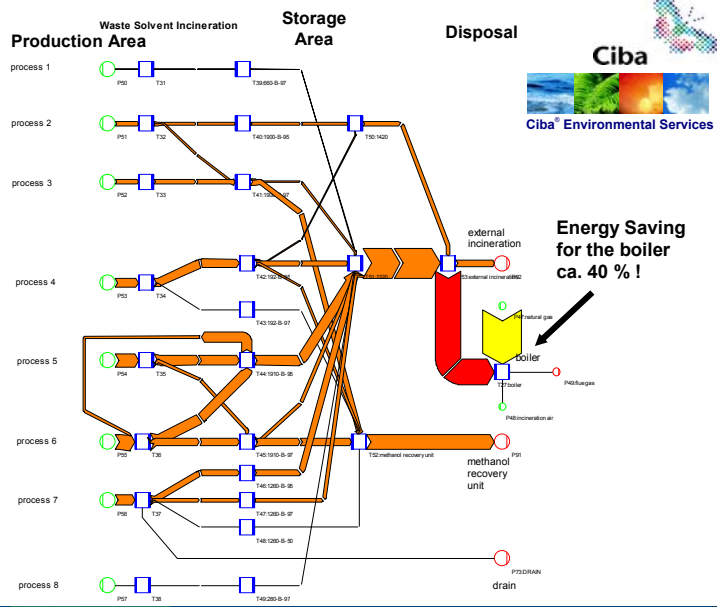


Eco-Engineering: Solvents burned in a boiler

Side effect:
35 t/year
product
losses via
solvent were
identified and
reduced to
12 t/year!



... and energy recovery





Questions?