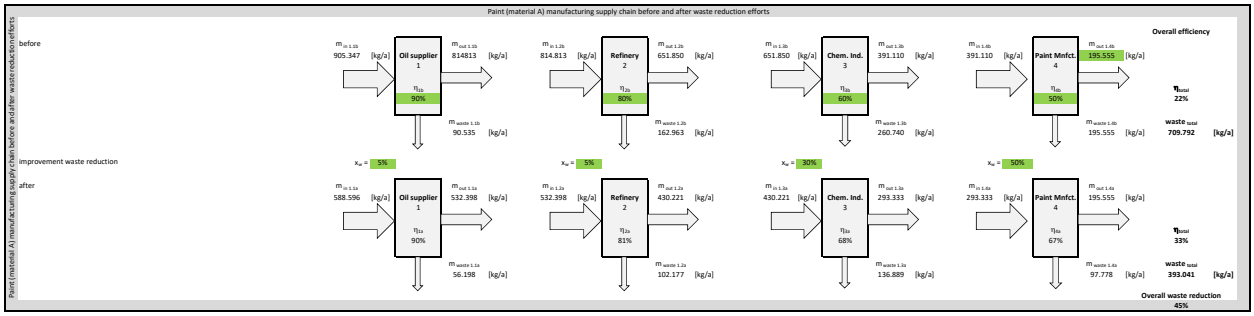
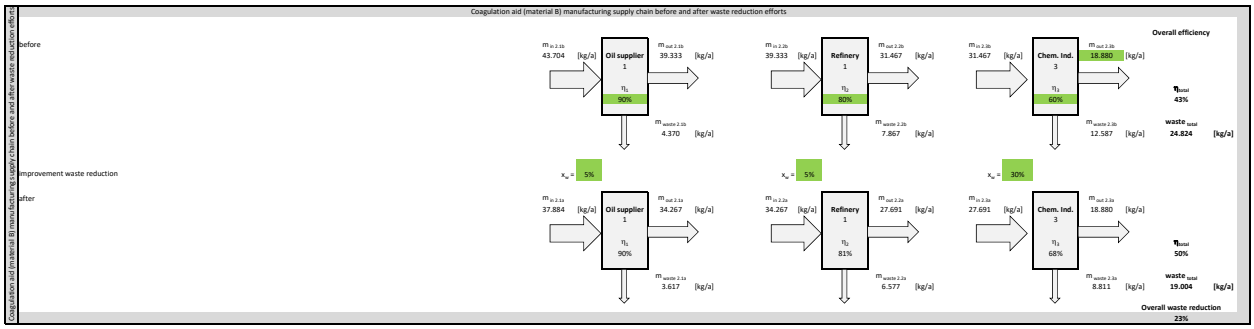
Efficiency improvement calculation Supply chain (excluding materials for energy supply)

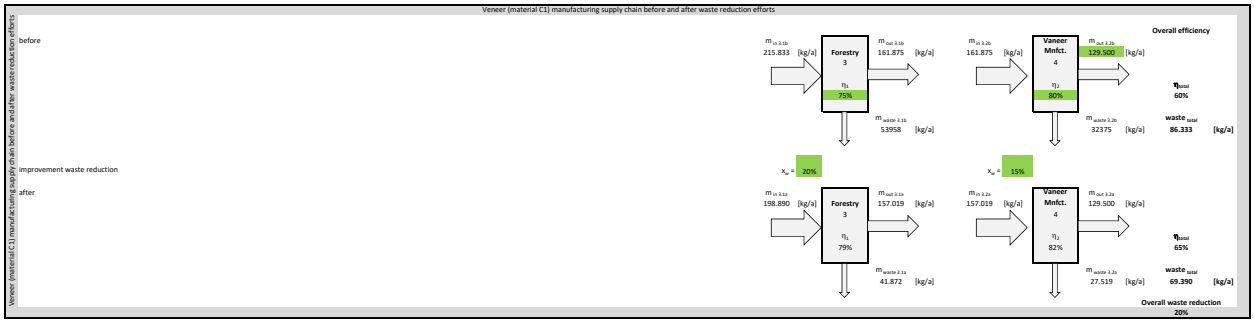
general equations	$\eta_1 = m_{out,a} / m_{in,a}$	(1)
	$m_{waste,a} = m_{out,a} (1/\eta_1) - 1)$	(2)
	$m_{in,a} = m_{out,a} (1/\eta_1)$	(3)
b = before, a = after	$m_{in,2} = m_{out,1} ((1 + x(\eta_1-1))/\eta_1$	(4)
Variable	x_w = improvent waste reduction betweeen status b and a in percent, e.g. x = 0.05 = 5 (5)	

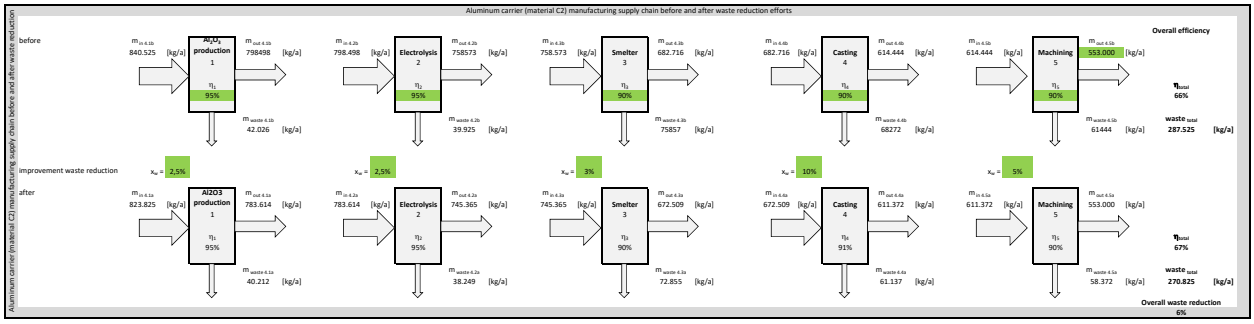
Supply Chain efficiency without optimization focal SME

overall SC material demand before optimization	2.867.505 [kg/a]	**overall SC material demand reduction without optimization focal SME:**	**12,63%**
overall SC material demand after optimization	2.505.258 [kg/a]		
overall SC waste amount before optimization:	1.168.821 [kg/a]	**overall SC waste reduction without optimization focal SME:**	**30,99%**
overall SC waste amount after optimization:	806.573 [kg/a]		
total SC product output for SME without optimization focal SME	**1.698.685 [kg/a]**		
overall SC production efficiency before optimization:	59,24%		
overall SC production efficiency after optimization SC without optimization focal SME:	67,80%		









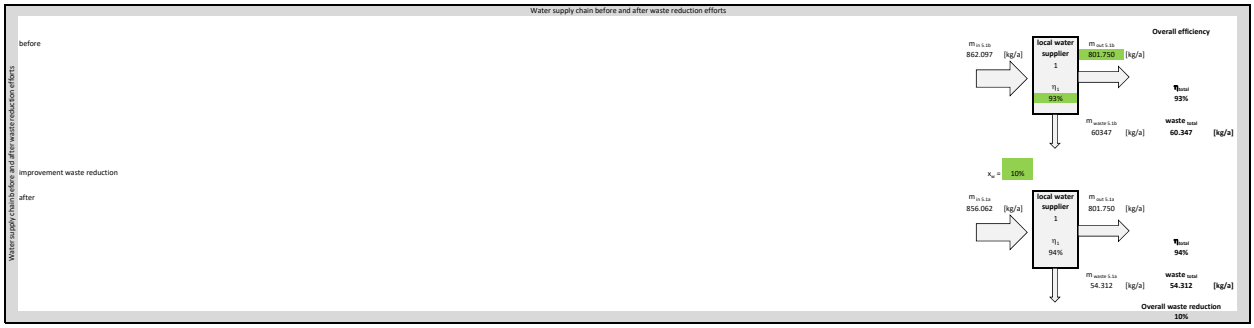


Figure S1: Material Flows Supply Chains

Efficiency improvement calculation Supply chain (excluding materials for energy supply)

general equations	$\eta_b = m_{out,i} / m_{in,i}$	(1)
	$m_{waste,i} = m_{out,i} \cdot (1/\eta_b - 1)$	(2)
	$m_{in,i} = m_{out,i} \cdot (1/\eta_b)$	(3)
b = before, a = after	$m_{out,i} = m_{out,i-1} \cdot (1 + x[s_i \cdot 1])/\eta_b$	(4)
variable	x_{wr} = improvent waste reduction between status b and a in percent, e.g. x = 0.05 = 5 %(5)	

Total Supply Chain and focal SME efficiency

overall SC material demand before optimization	2.867.506 [kg/a]	overall SC material demand reduction including optimization focal SME:	26,25%
overall SC material demand after optimization:	2.114.778 [kg/a]		
overall SC waste amount before optimization:	2.220.865 [kg/a]	overall SC waste reduction including optimization focal SME:	33,89%
overall SC waste amount after optimization:	1.468.137 [kg/a]		
product output focal SME	646.641 [kg/a]		
overall SC production efficiency before optimization:	22,55%		
overall SC production efficiency after optimization SC and focal SME:	30,58%		

Consumption of Example SME optimized (low investment option)

material demand focal SME before optimization:	1.698.685 [kg/a]
material demand focal SME after optimization:	1.461.283 [kg/a]
waste focal SME before optimization:	1.052.044 [kg/a]
waste focal SME after optimization:	816.642 [kg/a]

Figure 52: Material Flows Supply Chains and Focal Company