# 1.2 INPUT - OUTPUT ANALYSIS

This quantitative analysis explores potential for resource efficiency within processes by providing quantified indication of potential for improvement (through indication of Non Product Output Costs). Also, it is testing enterprise ability and willingness to provide quantitative data.

**Overview**

This analysis enables to estimate potential for improvement through a simple input – output analysis implemented at the enterprise boundary level (not specific processes).

At this stage data on major process inputs (materials and auxiliaries, water and energy) and their appearance within the desired product should be collected using the Table 1 **“TOP 20 inputs”**.

This analysis provides:

* Indication of theoretical potential for improvement of resource efficiency
* Information for identification of areas for improvement and target setting
* Data for quantification of an initial baseline
* Information for boosting commitment for change at the enterprise level.

Note that TOP 20 is not a comprehensive and complex input – output analysis. It is done only for most significant inputs within the company system boundary and it is based on annual figures from previous business year. Also there is one important rule to be considered: **Ask for (even very rough) expert estimation if real data are not available or cannot be gathered easily. It is better to be “approximately right than accurately wrong”.**

The TOP 20 table enables to quantify process loss for each important input (raw materials, auxiliary materials, energy, water or packaging) in the following way:

* Imagine the whole enterprise as a black box
* Select up to 20 most significant inputs. Importance of inputs should be evaluated against their bulky character, high environmental risks or significant costs.
* Estimate percentage of appearance of the given input within the final product (can be different products leaving the production process)
* The rest is a process loss – relevant input becomes pollution (somewhere within the “black box”); by pollution we understand any input material, energy or water resource which is leaving production as an unwanted loss and which creates risks to the environment including health and safety conditions.
* Quantify this process loss also in monetary terms as we know annual costs of the given input.
* Add pollution treatment costs if relevant and available.

**Detailed guidance how to implement this analysis is provided in ANNEX 1 "TOP 20".**

Data gathered within TOP 20 together with data on annual production can be in some cases used for **benchmarking,** which can provide further insight into the quantification of the potential for improvement. A SME can utilise TOP 20 as basis for their key performance indicators within resource efficiency.

**TABLE 1: TOP 20 inputs – Quantification of process losses** [based on annual data]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***No*** | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | ***Remark***  ***(potential for conservation)*** |
| ***Input*** | ***Total amount***  ***[t]*** | ***Total costs***  ***(kEUR)*** | ***Product Out-put %*** | ***Process***  ***loss***  ***%*** | ***Process loss***  ***(kEUR)*** | ***Pollution treatment costs (kEUR)*** | ***Total loss***  ***(EUR)*** |
| 1 | Milk | 60.000 | 15.000 |  |  |  |  |  |  |
| 2 | milk | 30.000 | 7.500 | 97,5 | 2,5 | 188 | 0,750 | 188 |  |
| **3** |  |  |  |  |  |  |  |  |  |
| **4** |  |  |  |  |  |  |  |  |  |
| **5** | **Water** | **247.000** | **75** | **0** | **100** | **75** | **248** | **323** |  |
| 6 | Cleaning agents | 7 | 14 | 0 | 100 | 14 | 0 | 14 |  |
| 7 | Disinfectants | 15 | 75 | 0 | 100 | 75 | 0 | 75 |  |
| 8 | Packaging | 40 | 80 | 0 | 100 | 80 | 0 | 80 |  |
| **9** | **Electricity** | **7 GWh** | **700** | **0** | **100** | **700** | **0** | **700** |  |
| **10** | **Natural gas** | **3.000.000 sm³** | **1.050** | **0** | **100** | **1.050** | **0** | **1.050** |  |
| 11 |  |  |  |  |  |  |  |  |  |
| 12 |  |  |  |  |  |  |  |  |  |
| 13 |  |  |  |  |  |  |  |  |  |
| 14 |  |  |  |  |  |  |  |  |  |
| 15 |  |  |  |  |  |  |  |  |  |
| 16 |  |  |  |  |  |  |  |  |  |
| 17 |  |  |  |  |  |  |  |  |  |
| 18 |  |  |  |  |  |  |  |  |  |
| 19 |  |  |  |  |  |  |  |  |  |
| 20 |  |  |  |  |  |  |  |  |  |

# ANNEX I TOP 20 – SIMPLIFIED INPUT – OUTPUT ANALYSIS

**Quantification of potential for improvement within material and energy flows**

This tool enables to estimate the theoretical potential for increasing material and energy efficiency through a simple input – output analysis at company system boundary level. The result of the input – output analysis is a quantification of “total loss” which at the same time represents:

* natural resources which were wasted
* financial losses
* pollution and harmful substances that are discharged from the production process and consequently have an impact on the quality of working conditions and/or on the environment.

Results of this simple analysis are often surprising for the enterprises which are seldom used to monitor losses related to production of waste and pollution.

Experience from many cleaner production projects shows that losses in production processes related to pollution (including the price of input materials which were not turned into the desired product) are much higher than costs for treating pollution. *For example analysis of results of cleaner production projects implemented in 50 industrial sites in the Czech Republic showed ratio of pollution costs related to processes (costs related to input flows before they become pollution) and costs related to pollution treatment to be in the average of 12 : 1 (Source: Czech Cleaner Production Centre).*

The TOP 20 analysis focuses on natural resources which are wasted within processes and on related financial losses.

*For collection and processing of data utilise the TABLE 1:* ***TOP 20 inputs – quantification of losses within processes, which is based on annual data from previous financial year.***

In order to fill in table 1 of TOP 20 the following steps should be followed.

* 1. **Imagine the enterprise with its processes as a “black box” with the following inputs and outputs:** 
     + **INPUTS** - flows entering the production process like raw materials, auxiliary materials, energy, water or packaging.
     + **OUTPUTS -** Inputs can become at the output of the “black box” part of:
* PRODUCT – desired output of the process
* POLLUTION – unwanted outputs of the process to be treated
  1. **List 20 most important material inputs**

Criteria of importance for identification of listed flows are:

* Toxicity
* Total costs
* Bulky materials

*Fill in column A within the TABLE 1. Do not forget water and important energy carriers also in form of fuels.*

*It is not necessary to fill in data exactly for 20 inputs, however, this number proved to be sufficient to include all important inputs which could become a priority for improvement and which are reasonable to be processed within the limited time.*

*Inputs with similar properties and similar use within the process can be grouped into one item.*

* 1. **For each listed input quantify**
* Annual amount
* Average annual costs

*Within the TABLE 1 fill in B and C and do not forget to fill in the right unit. Source of data can be invoices and enterprise books, do not hesitate to make rough estimations if better data is not readily available.*

* 1. **For each listed input estimate percentage of appearance of this input within the final product.**

Allocation rule is that any resource which does not leave production process as part of a product is a loss and consequently also pollution somewhere.

*Estimated ratio of Product Output (PO) should be filled in percentage [%] within TABLE 1. (column D). Do not hesitate to ask for very rough expert estimation again if there is not more accurate data available (it is better to be “approximately right than accurately wrong” - and enterprises are accurately wrong if they relate all production costs only to PO).*

*Auxiliary materials or energy do not appear in the final product, thus their values in column D is 0%.*

* 1. **Estimate process loss.**

All material inputs and their parts which do not appear at the output side as part of the product can be considered for the sake of this analysis a process loss[[1]](#footnote-2).

**process loss in % (E) = 100 % - PO in % (D)**

*Calculate process loss in % within E in TABLE 1. Auxiliary materials become 100% loss. In this simplified analysis also all energy inputs are considered to be process loss at 100%.*

You can quantify process loss in monetary terms as total annual losses related to particular input:

**process loss in EUR (F) = total costs in EUR (C) x process loss in % (E)**

* 1. **Add pollution treatment costs**

This part of the analysis focuses on pollution flow(s) related to given input and on harm related to their treatment and impact within the environment. In column G you can add pollution treatment costs associated to the losses of the specific input.

The total loss in column H of TOP 20 table is the sum of process loss (F) waste and emission treatment costs (G).

**process loss (F) + pollution treatment (G) = total loss (H)**

*This column of TOP 20 can be omitted if relevant data is not (easily) available.*

The above described analysis enables to evaluate process loss and consequent pollution from point of view of economic losses and environmental risks and to draw conclusions on potential for cleaner production. It provides background information for selection of possible focus areas for full scale implementation of CP project, target setting and identification of baseline. Quantified estimation of costs of process loss and indication of potential for improvement can facilitate necessary commitment of enterprise management.

1. From the perspective of Material Flow Accounting the process loss as defined here is part of the Non Product Output (NPO). NPO costs contain also the energy, labour and other costs related to processing input before it becomes waste. For the sake of this simplified analysis is sufficient to relate losses only to the costs of input materials as these are usually the biggest part of the total NPO costs. [↑](#footnote-ref-2)