MODEL FOR CALCULATION OF KEY ENERGY PERFORMANCE INDICATORS FOR PULP AND PAPER MILLS

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1. Introduction

This document describes a model that allows for a harmonized way of calculating key performance indicators (KPIs) for energy use in pulp and/or paper mills. Through the model, specific KPIs for electricity, heat and fuel consumption, which relate energy use to annual production volumes, are calculated. By clear definitions of the energy flows included in a certain KPI, the model is intended to allow for comparison of results between different mills. However, the energy systems differ between mills with different types of pulp and paper production. The required input data and calculation procedures are therefore adapted depending on the type of production. For all types of mills, input data is given on an annual basis and calculated KPIs apply to that given year.

The distinction between different kinds of pulp essentially follows the BREF document and the BAT conclusions for pulp and paper, i.e., the model distinguishes between:

- Kraft pulp
- Sulphite pulp
- Mechanical pulp
- Recycled fiber pulp
- Paper

In the case of integrated mills, efforts were made to differentiate between energy consumption for pulp production and paper production respectively. Similarly, in the case of mills producing more than one type of pulp, the energy consumption associated with each type of pulp is determined separately. This division makes it possible to compare the same type of production between mills regardless of whether this is the only type of production in the individual mill or whether there is also another type of production in the mill. For example, the production of kraft pulp at a market pulp mill can be compared to the production of kraft pulp at an integrated pulp and paper mill where both kraft pulp and mechanical pulp are produced.

This document presents an general description of the purpose of the calculation model and its intended use. A more detailed description of the defined KPIs and how they are calculated can be found in separate PMs for each type of mill, which also include flowcharts and descriptions of applied system boundaries.

2. General description

The model calculations start from the energy flows existing in a pulp and/or paper mill. In principle, the same calculation method can be used regardless of the type of pulp or paper produced as long as the same energy flows exist in the mills. However, since there are different energy flows in, e.g., a kraft pulp mill compared to a mechanical pulp mill, or, in an integrated pulp and paper mill compared to a non-integrated pulp mill/paper mill, separate calculation methods were designed to be adapted to the respective production types.

The purpose of the model is to define the energy flows to be included in a certain KPI. Roughly, these can be divided into one of the following categories:

- energy flows into the mill
- energy conversions in boilers, turbines and furnaces
- energy utilization in the production of pulp and/or paper
- energy flows out of the mill.

The fact that the same calculation model can be used for two different mills does not necessarily mean that they are comparable in the sense that energy use can be expected to be on the same level. Although the energy flows are more or less the same and the same calculation model can be used for, e.g., a TMP mill and a CTMP mill, the results cannot be directly compared.

Even for mills with the same type of pulp production, there are a number of factors that affect the energy consumption, such as wood raw material, kappa number, degree of bleaching and paper quality. The purpose of the model is ***not*** to be a tool for evaluation and comparisons where such factors are taken into account. The calculation model is only the first step to ensure that *the KPIs are calculated in the same way, i.e. with the same system boundaries and the same energy flows included.*

KPIs are calculated separately for electricity, heat, fuel and fossil fuel. For heat, the KPIs include both steam and hot water consumption. For electricity and heat, the KPIs provide a measure of the energy efficiency of the pulp and paper production processes. For fuel consumption, however, the KPIs also capture the efficiency of the boilers' energy conversion and the extent to which fuels and by-products generated in the processes are utilized for energy purposes. The KPIs for fossil fuel consumption show to what exten the production is driven by fossil energy sources. The KPIs supplement each other and provide different perspectives on the energy use at a pulp and paper mill. The different KPIs say more together than *a single* KPI would on its own.

The calculation methods are designed to obtain KPIs for a non-integrated pulp mill that can be compared to KPIs for the pulp production at an integrated mill. Correspondingly, KPIs for a non-integrated paper mill should be possible to compare with the paper production of an integrated mill. For this to be possible, it is required that:

- the energy use for drying of pulp is calculated separately at mills with production of market pulp,
- the energy use for repulping of purchased pulp is calculated separately,
- the energy use in integrated pulp and paper mills is separated between pulp production and paper production with a boundary at the pulp storage tower,
- the energy use for mills with production of several types of pulp is separated between the different pulping processes.

In addition to comparing the energy use between different mills, the model can be used to compare the energy use of the same mill over time. This enables a clear way of showing how technological development and other process changes have affected energy use.

Figure 1 below shows a simple sketch of the system boundaries set for the model. Depending on which KPI is calculated, the system boundary can be defined differently . For some KPIs, the system boundary is set around the entire mill, from the point where the wood enters the woodyard to the point where the final product (pulp and/or paper) is ready for external delivery. For other KPIs, the system boundary is set around the core production process, i.e., after the fuel has been converted into steam and electricity. The definition of system boundaries for different KPIs is reported in more detail in the PMs for specific types of mills. Energy use for support systems such as office heating, water treatment and internal transports is also considered in the model. Consequently, the resulting KPIs include all energy in the form of electricity, heat or fuel that is supplied to or delivered from the mill.

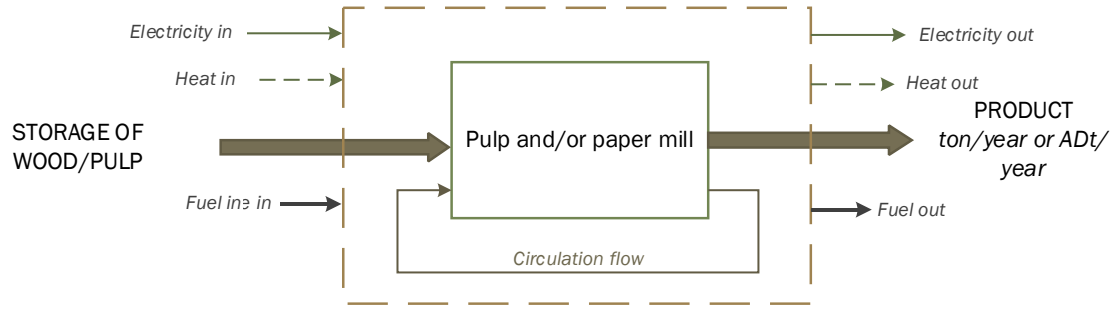

Figure 1. Illustration of system boundaries

Even if the same main product is produced (e.g. kraft pulp or paperboard), most mills differ in some way in process design, which means that energy use and energy flows may be different. Our intention has been to design a number of type models that can be used for all mills with a certain type of production.