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WORK PACKAGE 2: GUIDELINES FOR WASTE FRAMEWORK DIRECTIVE: EVALUATION OF STAKEHOLDER COMMENTS AND ASSESSMENT OF RELATED IMPACTS AS INPUT FOR GUIDANCE DOCUMENT

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Expert team for assessing and guidance for the implementation of Waste legislation

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1 Evaluation of Stakeholder comments related to Guidance on the R1 Energy Efficiency Formula in Annex II of Directive 2008/98/EC on Waste and assessment of potential impacts

This report contains a summary evaluation of all Stakeholder comments so far received to the issues addressed under the topic "identification of issues for a guidance document" in the first meeting of the expert group on R1 efficiency in June 2009 ("R1 energy efficiency formula – identification of issues for guidance"; presentation Andreas Versmann – DG Environment, 26 August 2009, sent to the working group on 3 September 2009), including proposals of new issues to include and a first evaluation and illustration of potential impacts, to form a basis for the further development of the guidance document".

For reasons of clarity and consistency the compilation of comments and proposals follows the order of questions addressed in the version of the EU presentation sent out to workshop participants.

Following the questions addressed during the meeting of the expert working group the following aspects can be identified as priority issues for guidance on the R1 energy efficiency calculation.

- Definition of R1 system boundaries
- The definition and determination of energy flows (Ep, Ef, Ei and Ew)
- Specifications of the R1 formula (comitology)
- Scope of the R1 formula
- Monitoring compliance with the R1 formula

As a follow-up of the meeting the members of the working group were asked to submit comments concerning the questions discussed in the meeting to DG ENV. Comments have been submitted by the representatives of Portugal, the United Kingdom, Austria, Belgium, France, the Netherlands and, as a joint document, by Cewep, Eswet and FEAD. These comments have been evaluated in this intermediate report. The German proposals in a draft guidance, which has been distributed before the meeting, have been taken into account as well.

In detail the following questions are discussed and received comments evaluated:

No	***Questions discussed and evaluated***
1	*Is there a need to define system boundaries of the R1 formula apart from the definition of the single factors of the formula?*
2	*Is the system boundary of the R1 formula identical with the boundaries of the facilities permit?*
3	*Out of the system boundaries: a) Flue gas cleaning? b) Other waste treatment, pre-treatment? c) Another classic boiler, combined process?*
4	*How is energy which is used by the incineration plant to be calculated? a) Energy used for flue gas cleaning? b) Energy used for other purposes?*
5	*If self-consumed energy is calculated as Ep, should own electricity consumption be multiplied by 2, 6 and own heat consumption by 1, 1?*

6	*Heat energy: what is "commercial use"? Is own consumption of the incinerator "commercial use"?*
7	*What about energy that is sent to third party but not or not efficiently used?*
8	*What about energy losses due to transport of heat energy?*
9	*How to calculate heat energy which is transformed to electricity by a third party?*
10	*How are backflows of generated energies to be calculated?*
11	*What is the definition of fuels?*
12	*Only non-waste fuels (RDF and waste-oils)?*
13	*How does one determine the moment fuel contributes to steam production?*
14	*How to make a distinction between Ef and Ei?*
15	*Should incoming electricity and heat flows be calculated with the factor 2,6 and 1,1?*
16	*How to account return flows from internal and external users?*
17	*Should circulating heat and electricity for self-consumption be calculated as Ei?*
18	*Ew to be calculated on the basis of the net caloric value (NCV)?*
19	*Is only municipal waste to be considered in Ew and all other wastes as Ef or Ei?*
20	*Should local climatic conditions be taken into account (WFD Art 38(1) 3rd sentence) and how could this be done?*
21	*Should local conditions in outermost regions be taken into account (WFD Art 38(1) 4th sentence) and how could this be done?*
22	*What are facilities dedicated to the incineration of municipal waste (MSWI)?*
23	*Municipal solid waste (MSW) a) defined in chapter 20 of the List of Waste (2000/532/EC)? b) including also pre-treated municipal waste from chapter 19 of the List of Waste (RDF)? c) defined in Art 3(3) of directive 2000/76/EC on the incineration of waste?*
24	*Are MWI which apart from MW incinerate other wastes not in the scope of the R1 formula? Should municipal waste be the largest part of the input of the MWI?*
25	*Is each waste input into a MWI, which is classified as R1 to be regarded as recovered?*
26	*Should certain waste be exempted? a) Non-municipal waste, b) waste with a low calorific value (>6000 KJ/kg), c) hazardous waste, d) separately collected municipal waste (bio-waste, plastic, wood)*
27	*May other provisions of the WFD lead to restrictions in the application of the R1 formula? a) the recovery definition, b) the waste hierarchy, c) the requirements on the protection of health and environment (Art 13)*
28	*The energy efficiency is calculated on the basis of the annual performance regarding the factors of the formula. a) Existing plants? b) New plants?*
29	*Revision of monitoring results?*
30	*How should Ew net calorific value (NCV) be measured? a) sampling of waste, b) other methods, alternative method could be boiler heat load (continuous monitoring? instead of (annual) direct CV measurement of waste. Effects of the facility equipment on the results?*
31	*Transitional period, when efficiency is not achieved due to decrease of energy consumption by third parties?*
32	*Verification (independent expert)?*
33	*How shall information on R1 status be communicated concerning trans-boundary shipments?*

Specifications concerning the application of the R1 formula have a special status in this document. According to the outcome of the first meeting they will be legally binding and thus will be subject to a comitology procedure (Art. 38(1) 2nd sentence WFD) and should probably not be addressed in an EC Guidance document. For reasons of completeness comments on this issue however, are also comprised in this evaluator chapter.

All proposals and comments related to the following equation as proposed in the WFD.

$$\text{Energy efficiency} = \frac{E_p - (E_f + E_i)}{0.97 * (E_w + E_f)}$$

Ep *means annual energy produced as heat or electricity. It is calculated with energy in the form of electricity being multiplied by 2.6 and heat produced for commercial use multiplied by 1.1 (GJ/year)*
Ef *means annual energy input to the system from fuel contributing to the production of steam (GJ/year)*
Ei *means annual energy imported excluding Ew and Ef (GJ/year)*
Ew *means annual energy contained in the treated waste calculated using the net calorific value of the waste (GJ/year)*

It should be noted that according to Annex II the formula should be applied in accordance with BREF on incineration.

The equation to calculate the plant efficiency (Pl ef) in the BREF document is based on the following assumption:

The exported (sold) energy minus the net part of imported energy is divided by the total energy demand for the waste incineration process, including flue-gas cleaning, generation of heat and electricity etc.

$$\text{Pl ef} = (\text{Oexp} - (\text{Ef} + \text{E imp}))/(\text{Ef} + \text{E imp} + \text{E circ})$$

all figures as equivalents in accordance to BREF, Chapter 3.5.6
Ef = annual energy input to the system by fuels with steam production (GJ/y)
E imp = annual imported energy (Note: energy from the treated waste (Ew) is not included)
E circ = annual energy circulated
Oexp = annual exported energy (combined total of heat plus electricity as equivalents)

If the result is higher than 1:

This shows that the plant minus imported energy with steam production is exporting (BREF) or producing (ECJ) more energy than that which is required to operate the total waste incineration process.

Because the calculation does nearly not take into account the energy content in the waste, it only allows efficiency comparison of incinerators processing similar wastes. This calculation does not require knowledge of the energy content of the waste. However, the result will be influenced by the waste energy content, and it can be expected that wastes with higher energy content can result in greater energy exports, and hence higher values of Pl_{ef}.

The relation between the R1-figure and the BREF Waste Incineration can be explained as follows:

The denominator of the R1 formula is deduced from the boiler efficiency formula[1]:

$$\eta b\ (97\ \%) = (Eh/st\ boiler/0.97x(Ef + Ew))x\ 100\ \{\%\} => 0.97\ x\ (Ew + Ef)$$

The numerator of the R1 formula is referring to the plant efficiency formula (Pl ef)[2]:

$$Pl\ ef = (Oexp - (Ef + Eimp)/(Ef + Eimp + Ecirc) => Oexp - (Ef + Eimp)$$

All amounts of energy (Ep, Ef, Ei, and Ew) are declared in GJ/a or MWh/a. By using equivalent values for Ep, Ef and Ei the ratio can be higher than 1. Primary fuels are put into account without equivalent value, because no conversion of energy is connected with it.

In contrast to the BREF calculation however, instead of the exported energy (Oexp), the factually used energy (Oprod) from the produced energy (Eh/st boiler) is used as basis. (Oprod) is the sum of the exported energy and the in house produced energy used internally. For standardization the marking Oprod was changed to Ep and Eimp to Ei. Ecirc does not appear in R1 formula; Ew does not appear in the BREF formula.

$$Oexp - (Ef + Eimp) => Oprod - (Ef + Eimp) =>Ep - (Ef + Ei)$$

That means that the calculated R1-factor gives the relation between:

(a) the really used energy (exported energy plus technically and economically feasible internally used energy) minus the imported energy, and

(b) the energy from waste plus other imported energy used for steam production (this are 97% of the energy used in the fire).

The project team has the opinion, that the question, whether these changes comprise the appropriate arguments for counting or not counting internally used (circulated) energy in Ei if the flue gas treatment system is within the system boundary is essential for the guidance on system boundary and the single parameters and that further discussion/clarification is needed.

[1] BREF Waste Incineration, Annex 10.4.4, page 599

[2] BREF waste Incineration, chapter 3.5.6, page 199 as well as annex 10.4.5, page 600

1.1 Definition of System Boundaries

Q1: Is there a need to define system boundaries of the R1 formula apart from the definition of the single factors of the formula?

All Stakeholders share the opinion that there is a need to clearly define system boundaries apart from the definition of single factors of the formula. Several interpretations arise from placing system boundaries in different ways. A clear definition of system boundaries can be seen as one of the initial steps on which experts should get an agreement, according to the French authorities. Other definitions such as energy flows would spring more easily from a good definition of the system. UK's response additionally highlights financial aspects. It is stated that unpredictable changes to R1 classification will undermine project economics.

The aspect of system boundaries is suggested to be addressed at a prominent position in the guidance, because the definition of the single factors seems to be directly linked to system boundaries. Several arguments supporting this recommendation have been provided by relevant stakeholders. General information and explanations might even be already part of an introduction chapter. A schematic diagram of the incineration process showing the envelope of the system boundary is suggested as useful illustration tool.

Q2: Is the system boundary of the R1 formula identical with the boundaries of the facilities permit?

The system boundary of the R1 formula is often incongruent with the incineration permit, according to all respondents. However, explanations vary. Austrian representatives argue that the energy production can be operated by a different company than the incineration facility. The conditions for the facilities are laid down in different permits. The R1 formula addresses only the incineration facility whereas the installation covered by the permit may include much more than that. According to CEWEP-ESWET-FEAD and Belgium any installation outside the responsibility of the operator are to be excluded from system boundaries. UK's response recommends a case-by-case determination of system boundaries by a competent authority. German authorities do not answer this question explicitly, but in an exemplary calculation of the R1 include all potential *internal* energy uses of the plant (including heating purposes) related to the combustion process.

The project team supports the opinion that the system boundary is not necessarily identical with the facilities permit but that guidance on what is envisaged should be given. Various statements supporting this conclusion can be found within relevant stakeholder documents.

Q3: Out of the system boundaries: a) Flue gas cleaning?

The issue of system boundaries and the definition of Ep (and Ew, Ef, Ei) are similar issue. According to the principle of energy balances, Ep, Ew, Ef and Ei has always to be defined as energy flow (input or output) to the system at the system boundary.

The topic is controversially discussed among stakeholders and comments provided by Stakeholders to system boundaries, often are based on different interpretations of the correct allocation of self-consumed energy. There are arguments for both cases.

1. According to the CEWEP-ESWET-FEAD response the Flue Gas Cleaning system is an essential part of the incineration process and is usually located within the limits of the installation. Therefore, it should be inside the R1 formula system boundaries. This is also supported by Austrian and German authorities. It is also stated that the flue gas cleaning is identical with the facility permit and is under the influence of the operator of the incineration plant. France and the Netherlands also locate the flue gas cleaning system inside system boundaries.
2. In contrast to that Belgium argues that the inclusion of the flue gas treatment installation could be a stimulus for incineration operators to spend less effort on treating flue gases and only use that amount of energy that is required to reach the maximum emission standards. This would be a counterproductive side-effect of a formula that was introduced to protect the environment. Therefore the flue gas treatment installation should be outside the system boundaries. The UK also shares this point of view. The argument provided by Belgian respondents was deemed as important to consider.

The BREF document on waste incineration also implies that flue gas cleaning should be inside the system boundaries.

In the following currently used system boundaries are compiled and the impacts of inclusion or exclusion on the single parameter will be demonstrated to the extent possible.

Following a first interpretation the R1 formula shall only include the combustion chamber as shown in Figure 1. In this case Ep is the energy generated in the combustion chamber and Ei is exclusively the energy used for the incineration process (e.g. combustion chamber (heat) and turbine (electricity). Ep in this case corresponds to a large extent to Eexp. Only few internal uses have to be added.

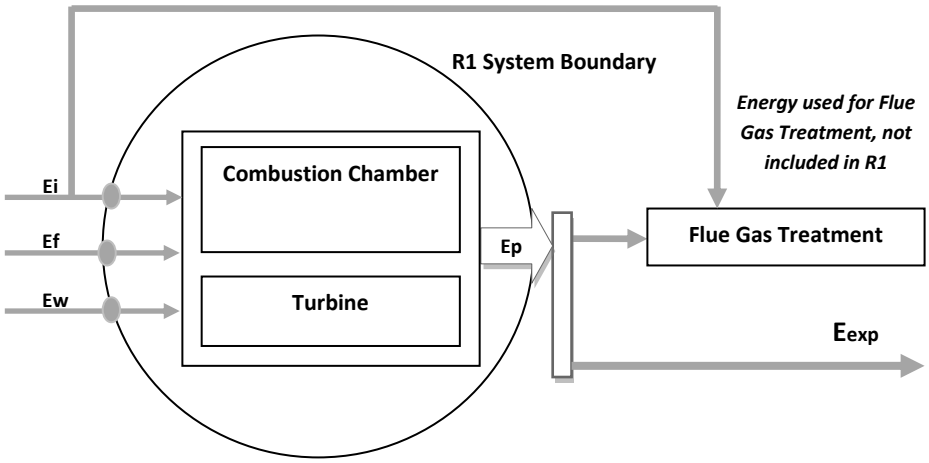

Figure 1-1: Narrow system boundary for MSWI energy efficiency calculation

If flue-gas cleaning is outside the system boundaries Ep means energy produced by the boiler = gross energy production.

Following the second interpretation, the flue gas treatment system is included in the system boundaries as depicted in Figure 2. Ep remains defined as the Sum of E internal uses and Eexp. Ei in this case comprises external energy used for the incineration process and for the flue gas treatment.

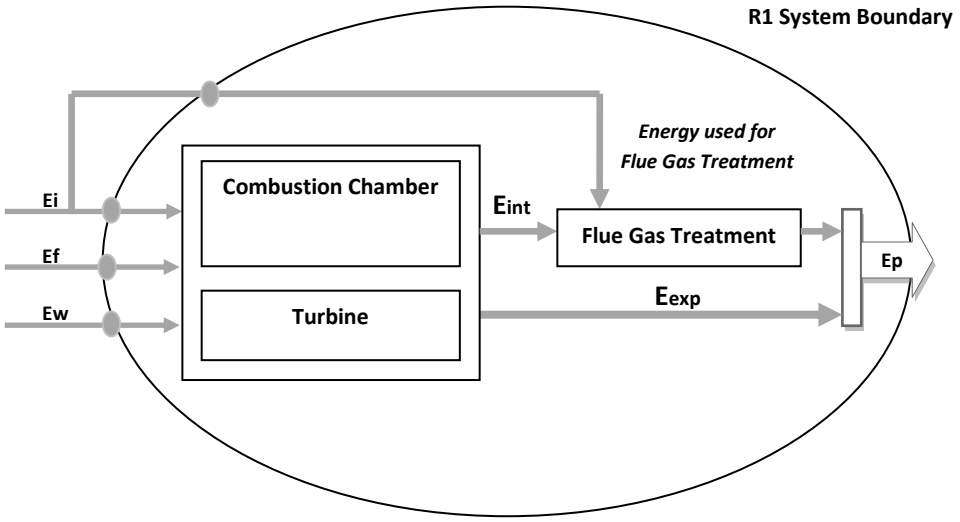

Figure 1-2: System boundary including the flue gas treatment system

In this case Ep means energy produced by the boiler = gross energy production if internal energy is used for flue-gas cleaning whereas external energy use would be counted in the equation as either Ef or Ei.

This approach seems to correspond to the mass flows provided by Germany and ESWET

In the context with such an approach the argument has been brought forward by Austria that an inclusion of self-consumed Energy within Ep without a balancing calculation as Ei in theory would lead to the possibility to be classified as R1 without any energy export to the web.

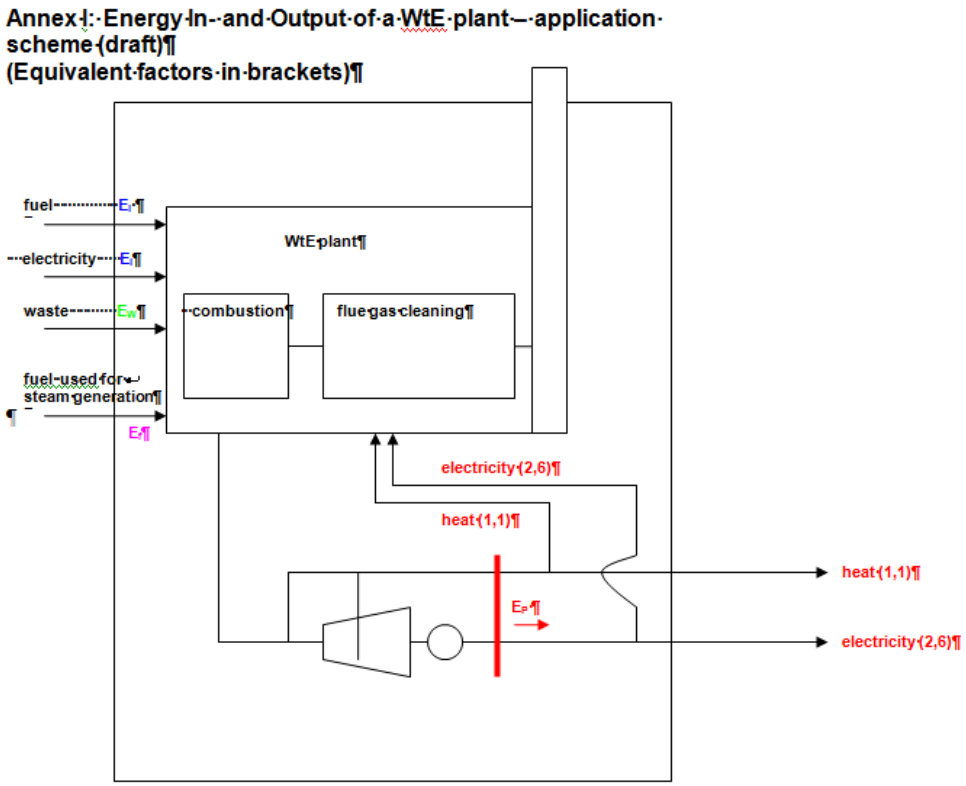

Figure 1-3: System boundaries including flue gas treatment, with E_p = sum E_{exp} and $E_{internal\ use}$.(Draft Guidance DE)

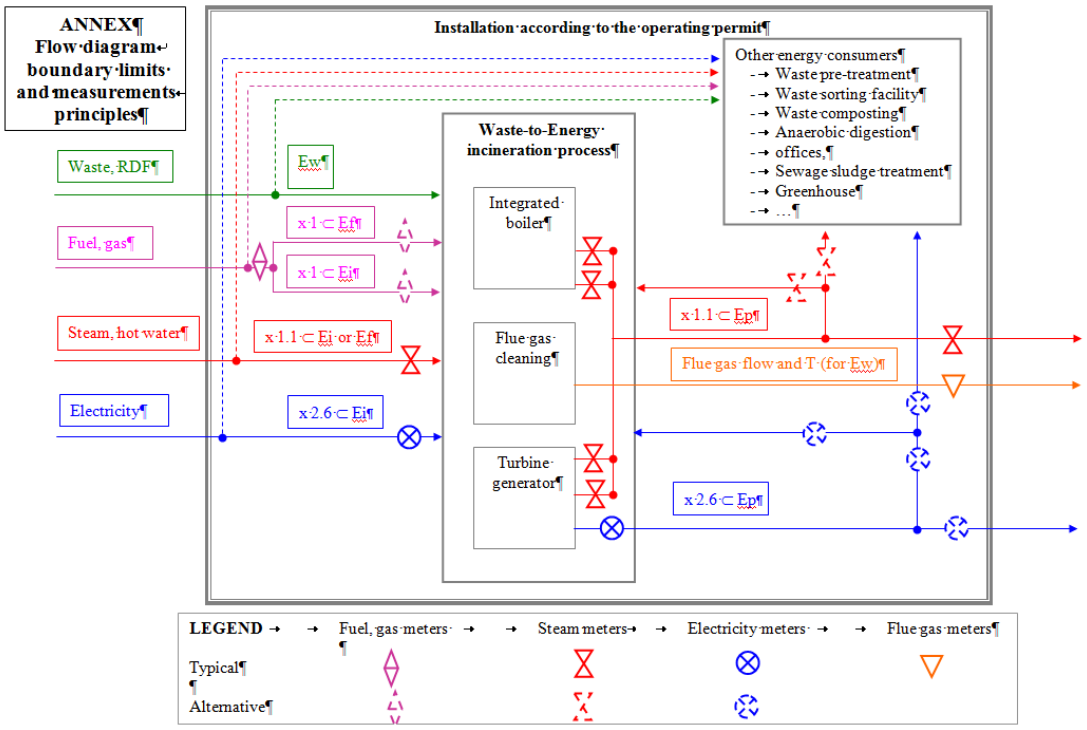

Figure 1-4: System boundaries including flue gas treatment, with E_p = sum E_{exp} and $E_{internal\ use}$.(Proposal ESWET)

Following the third interpretation, the flue gas treatment system is included in the system boundaries but only the energy leaving the system boundary is defined as Ep. In this case Ep is energy produced by the boiler – energy used for flue gas cleaning = net energy production.

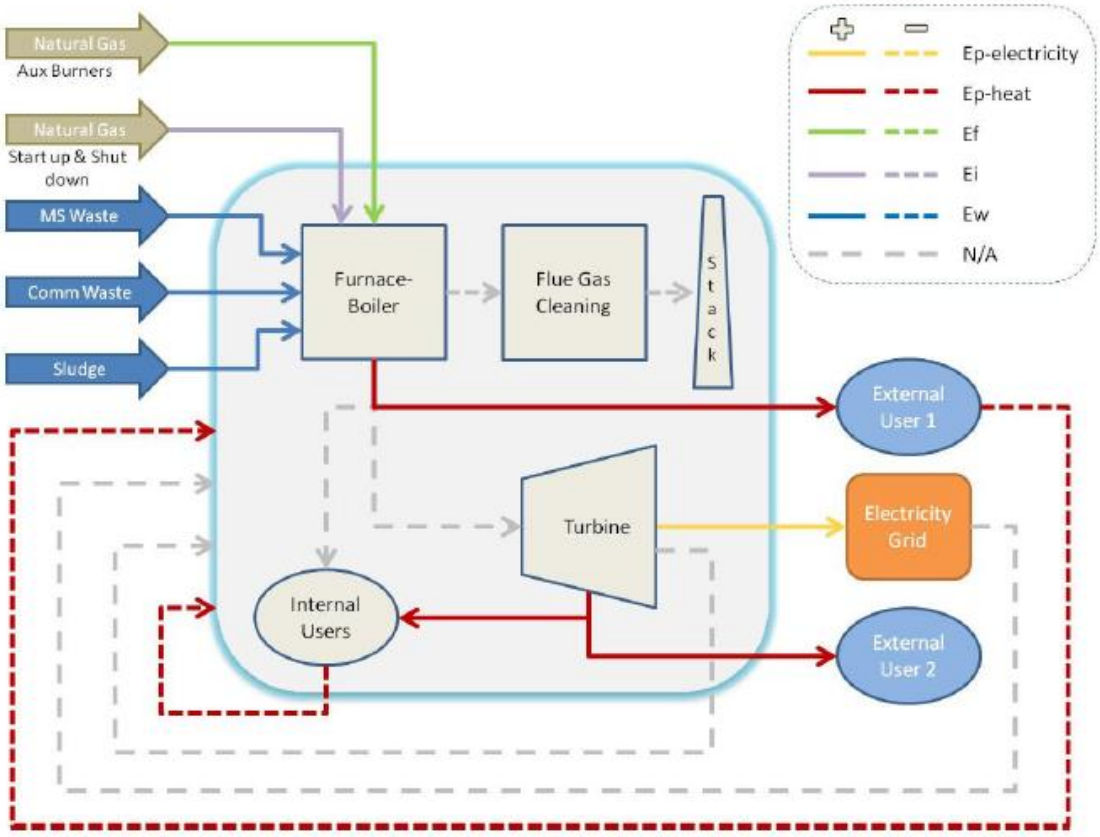

Figure 1-5: System boundaries including flue gas treatment, with $E_p = E_{exp}$ (OVAM Evaluation report of the R1 formula))

The forth interpretation is brought forward by the Netherlands and Austria.

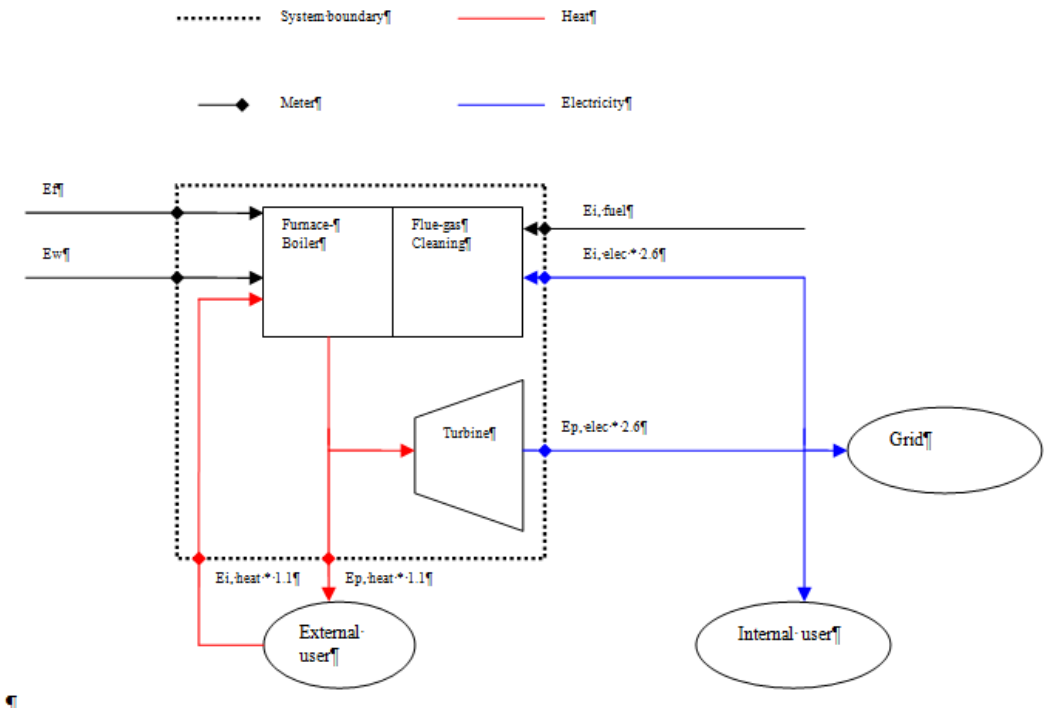

Figure 1-6: Mass flow including flue gas treatment but counting self-consumption as Ei (proposal NL)

Following this interpretation *internally used energy is included in Ep but also counted as Ei.*

Note: The inclusion or exclusion of the flue gas cleaning system might affect the achievable R1 factor. External Energy used for flue gas treatment (Ei) has no effect on R1 if the flue gas treatment is outside the system boundaries. If the flue gas treatment is inside the system boundary interpretations become divergent resulting in variations of the R1 factor of +/- 0,07 according to OVAM calculations.

In assessing the system boundaries it seems to be important to consider, that stakeholders agree in general agree that Ep = Eexp and E self-consumption

The project team is leaning towards including the flue gas cleaning system into the R1 system boundaries, because: flue gas treatment is considered to be a part of the incineration process, it is included as a part of the permit for the incineration process in most plants and putting it outside of the system boundary would generate confusion on operator´s side.

The question whether or not to include self-consumed energy as Ei needs to be decided upon.

The exclusion of the flue gas treatment system could be another reasonable option. If possible incentives to optimize flue gas treatment and to optimize internal energy recovery should be given and companies going beyond the minimum requirements should not be punished by an inappropriate system boundary.

Therefore the project recommends further discussion and investigation into the impacts and implications of the different alternatives.

The concerns expressed by Belgium seem to be based on the assumption that energy used for flue gas treatment either from internal or from external sources is counted as Ei. In this context it has to be noticed, that in practice the obligations to meet BAT standards as laid down in the BREF and emission levels laid down in the Waste Incineration Directive apply. The permit for an individual site determines what is BAT for a site and will set conditions accordingly. It is in general not expected that companies go voluntarily beyond these requirements.

Q3: Out of the system boundaries: b) Other waste treatment, pre-treatment?

Austria, Belgium and the Netherlands agree with the Commissions suggestion that processes/installations such as pre-treatment, sorting, recycling etc. are not to be placed inside the system boundaries. The UK's response partly includes pre-treatment if necessary due the particular design of the plant. For instance, if the plant requires that the waste should be shredded, energy used in this should be parasitic. France on the other side defines the wide-system and the narrow system (area). It is stated that an incineration plant might be associated with other waste management activities within the same permit. Thus the system to be defined could vary according to local circumstances. However, the system should always remain consistent in terms of outputs and inputs and the manager of the plant should be able to measure and monitor those. German authorities in an exemplary calculation take into account of additional internal uses of the plant such as heating of buildings/instruments/silos or turbo pumps for boiler water.

There are two alternatives to handle other treatment activities. In the first alternative they are considered to be out of the system boundary

As very well described in the comment from France, there are two alternatives

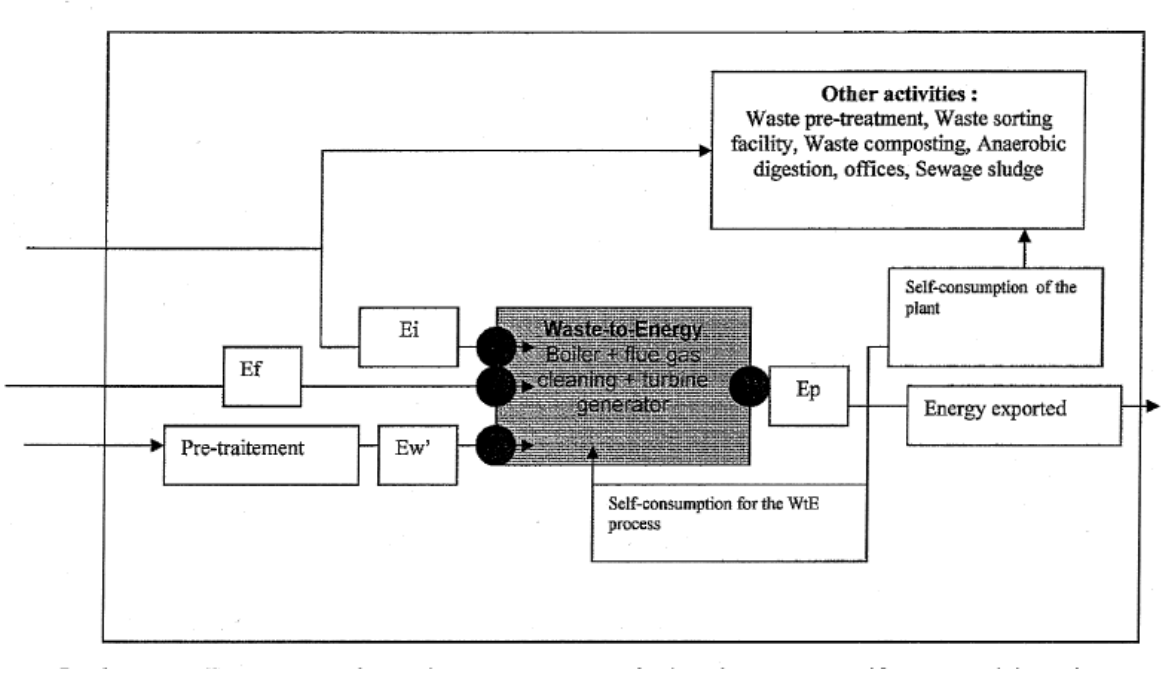

Figure 1-7: System boundary excluding pre-treatment and other activities in waste incineration plants

In the case of a system boundary restricted to the incineration unit as such, Ep comprises the exported energy and the energy self consumed for other activities within the plant. Ew is calculated on waste after pre-treatment and Ei does not include energy used for other activities within the plant.

In the second alternative other activities are included into the system.

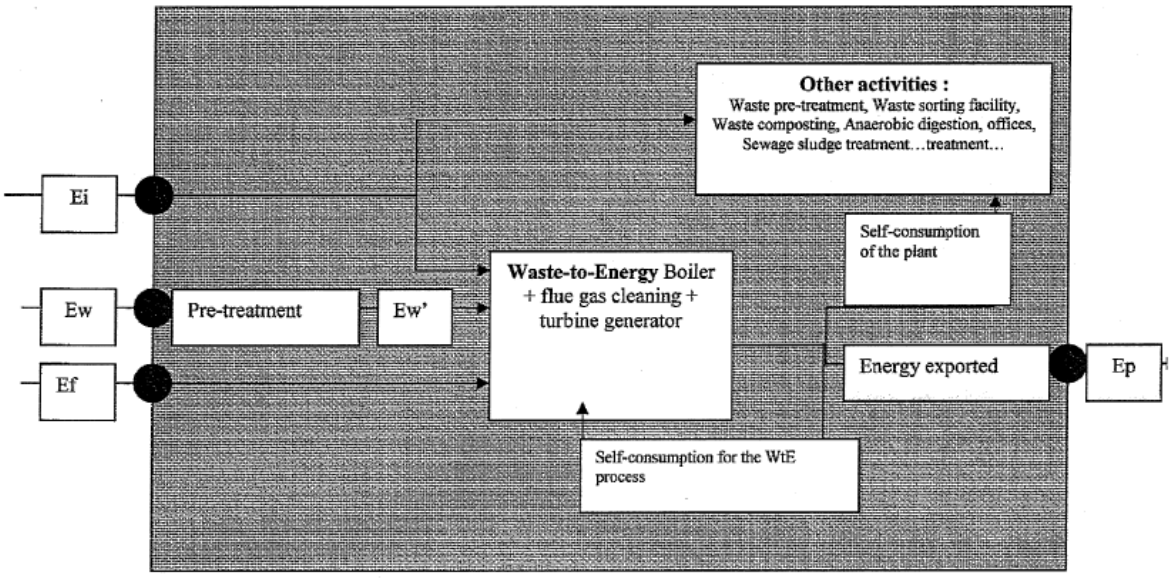

Figure 1-8: System boundary including pre-treatment and other activities in waste incineration plants

In the case of a system boundary including all activities of the plant, Ep if strictly regarded is restricted to the exported energy whereas the energy self consumed for any activity within the plant is not taken into account and Ei is over estimated because it includes all energy used for other activities within the plant.

This leads to a severe reduction of the R1 factor, which by far cannot be compensated by the fact that Ew is calculated on waste prior to pre-treatment.

An increase of the NCV or Ew (Ew < Ew') by means of a pre-treatment operation included in the system boundary can be explained with the same illustration.

The correlation between Ew and Ep is a complex and not linear one, so that predictions about effects without intensive calculations and background information seem to be difficult. However, it becomes clear from Figure 1-8, that inclusion of such a treatment operation into the system boundaries would tend to increase R1 as long as energy used for the treatment is not counted as Ei/Ef whilst it tends to lead to the opposite effect when external energy is used for the purpose.

The question whether e.g. drying of waste prior to incineration might need to be regulated separately can be answered in the way that Ew is not changed by a drying operation (reduction of mass) because it is a specific energy value (GJ/year), which is independent of mass.

The majority of stakeholder votes for the first alternative. On the basis of the arguments brought forward this position is supported by the project team in general, even more as pre-treatment is not an intrinsic part of an incineration plant.

Main arguments of the justification are: Pretreatment is typically not included in the permit of the installation and is not a necessary part of the incineration process, nor influencing it, as long as it does not influence the NCV of the waste. Furthermore, if the other treatment activities would be counted inside the R1 system boundary tendency might exist (if used Energy is counted as Ei) on operator side to use as little energy as possible for these activities in order to keep R1 results high. This might lead to an inappropriate operation mode of the other treatment activities. The argument that was used within the discussion of the flue gas treatment is not fully applicable here as detailed BREF requirements are not always available.

Q3: Out of the system boundaries: c) Another classic boiler, combined process?

Other classic boilers and combined processes are out of the R1-formula system boundaries (CEWEP-ESWET-FEAD). Belgium goes further and concludes that allowing the inclusion of installations running on primary fuels and all common parts would lead to system boundaries that are hard to define and could lead to illogical situations. Also the Dutch response excludes other classic boilers etc. However, if certain units are used by a waste incineration plant together with other plants, the waste incinerators share should be inside the system boundaries according to the Austrian response. France applies similar to the answer presented in b) the wide system and the narrow system view.

It is recommended that other waste treatment, pre-treatment and other boilers are not to be placed inside system boundaries as a general rule. Potential exemptions might be addressed in the guidelines.

Inclusion/exclusion of electricity production (turbine)

See Q9.

1.2 R1 formula: Ep

Q4: How is energy which is used by the incineration plant to be calculated? a) Energy used for flue gas cleaning? b) Energy used for other purposes?

Stakeholders in general agree that self-consumed energy should be contained in Ep, but there are different opinions as regards whether it has to be included in Ei.

According to German authorities the Ep = E internally used + E exported to the grid. France states, that in principle energy self-consumed by the flue gas treatment system is not going out of the system from a thermodynamic point of view, it contributes to the treatment of waste and could therefore be included in Ep, but that it depends on the ability to measure the energy produced by a system boundary restricted to the incineration unit and the flue gas treatment system, whether the self-consumption should be included in Ep or not. UK agrees that energy for flue gas cleaning should be an output and energy used for pre-treatment should be parasitic. UK does not respond for other uses.. All energy produced is part of Ep either as direct heat export from the furnace or as electricity produced by the generator (Netherlands). The JRC states that the meaning of Ep is the gross amount of energy from the turbine/generator.

According to CEWEP, Ep includes the produced energy which is used outside of the installation, as well as the energy which is used inside by the incineration facility and the rest of the installation to treat the waste and for other useful purposes. It is further explained that if the Turbine Generator (TG) is within the boundary limits of the R1 formula system, the total amount of electricity produced by the TG set is to be counted in Ep. It totalizes the electricity sold outside of the installation and the electricity used within the installation by the incineration facility and other energy users. The heat produced includes the heat exported for use outside of the installation and the heat used in the installation itself by the incineration facility or by other energy users. This heat can be in the form of steam, hot water or any other form.

Austria on the other hand states that self-consumption must be calculated in Ei. This view is supported by Belgium as regards electricity by stating that internal uses are to be included in Ei.

The project team recommends that energy that is used by the incineration plant (for various purposes inside the system boundary) is calculated as part of Ep (= gross energy production). This is in line with the view of the majority of stakeholders and existing guidance. What still needs to be clarified is whether the part of Ep used for self –consumption is also to be counted as Ei or not. The question needs further clarification and is to be answered together with the definition of system boundaries.

Q5: If self-consumed energy is calculated as Ep, should own electricity consumption be multiplied by 2.6 and own heat consumption by 1.1?

The electricity used by the plant needs to be multiplied by 2.6 and the heat by 1.1 (CEWEP-ESWET-FEAD, Austria, Germany, UK and Belgium, Netherlands).

These equivalent factors are used for the comparison of different kinds of energies produced by a WtE plant on the basis of the efficiencies of other thermal energy generators using primary fuels. On the one hand the equivalent factor 2,6 for the electricity generated at the generator is based on an average European coefficient of coal plants with 38%, which means a need for energy of 2,6 kWh of energy usage for the production of one kWh of electricity. The equivalent factor for the usage of heat is 1,1, based on an average European coefficient of heat plants of 91% , which means a need for energy of 1,1 kWh of energy usage for the production of one kWh of heat.

The justification for applying the factors of 1.1 and 2.6 is valid independently whether the energy is used outside or inside the system boundary. In this context it should also be taken into consideration whether the factor was applied in calculation of the threshold values of 0.6 and 0.65.

Q6: What is "commercial use"? Is own consumption of the incinerator "commercial use"?

Q6 is related to Q4 and 5 and to the definition of system boundaries.

Annex II to the new WFD stipulates that: Ep means annual energy produced as heat or electricity. It is calculated with energy in the form of […] heat produced for **commercial use** multiplied by 1.1 (GJ/year).

It can be observed that stakeholder responses vary significantly. The own consumption of the incinerator is "commercial use" as, if not provided by the waste, the energy required for the treatment of the waste would otherwise have to be imported (CEWEP-ESWET-FEAD). However, according to the definition provided in the Austrian response "commercial = related to buying and selling things" the self-consumption of the incinerator is not "commercial use". Belgium argues, that although apparently logic from the legal point of view, in practice it can be decided by the waste operator if heat for internal use will be regarded as commercial or not (sell all and sell back what is needed for internal use). As both options would stand in a legal dispute Belgium recommends to not make a specific choice in a guideline.

For UK it is not clear what would be the heat energy used by the incinerator. If it is for drying waste which is dictated by plant design, then it should be considered parasitic. However, flue gas cleaning outside the system boundaries should be defined as commercial use. Hence Stakeholders stated that a clear definition of "commercial use" would be helpful in order to create a common basis for discussion.

The project team supports the opinion that "commercial use" of produced energy should not be restricted to the heat which is sold to third parties but include self consumption of the incinerator, as the waste the required energy would have to be bought on the market if not provided by.

Q7: What about energy that is sent to third party but not or not efficiently used?
Q8: What about energy losses due to transport of heat energy?

CEWEP-ESWET-FEAD, Austrian, Belgium and UK stated that the efficiency of the use of exported energy must not be taken into consideration as it is outside of the installation boundaries limit and out of the R1-formula system boundaries. The UK understands the R1 formula to be about the efficiency of the MSWI plant and how efficiently the electricity it exports is used should not affect the classification of the plant as R1.

In line with all received stakeholder comments, the project team suggests not to consider inefficient energy use by a third party. The fact that energy is either not used or used inefficiently should not be taken into account and should have no effect on the R1 energy efficiency formula. Inclusions of decisions taken by third parties into the efficiency scheme appear to be hardly feasible.

The same applies in the case of energy losses due to transport of heat energy.

Q9: How to calculate heat energy which is transformed to electricity by a third party?

Energy which is transformed to electricity by a third party according to CEWEP-ESWET-FEAD shall not be considered because it lies outside of the installation system boundaries limit and out of the control of the operator. Austria recommends carrying out a calculation with the degree of efficiency of the external plant (third party). UK is primarily concerned with the efficiency of the MSWI and this should not be part of the calculation. MSWI efficiency should be calculated as 1.1 times heat output to third party.

The project team concludes that in accordance with previous questions, activities performed by third parties are out of control of the MSWI plant operator and should not be considered.

In discussing the impacts of heat energy being transformed to electricity by a third party instead of being transformed by the MSWI plant itself, certain concerns however, have been raised by Belgium that incineration facilities operating a turbine with lower efficiency than the EU average would tend to separate them from the plant.

There are two alternatives to answer the question how to handle the R1 formula related to electricity generating equipment (turbines).

The first alternative considers the turbine to be outside the system boundary. This means that only heat leaves the incineration plant which is multiplied by a factor of 1.1 to arrive at the Ep value for the calculation of the R1 result.

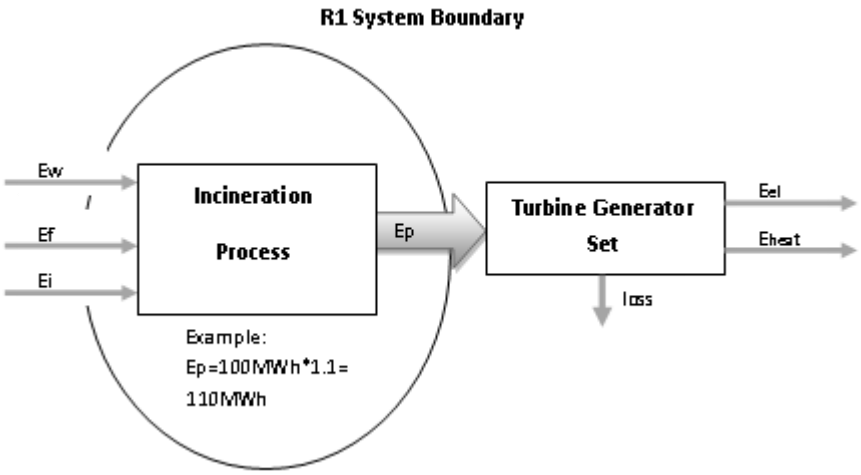

Figure 1-9: Ep in case of system boundary excluding turbine (exemplary figures)

The second alternative considers the turbine to be inside the system boundary. This means that the produced electricity contributes to the calculation of Ep with a factor of 2.6. With this factor an average efficiency of the turbine of 38% is taken into consideration.

In case that the included turbine would only produce electricity the accountable output of a given amount of boiler steam from the genuine incineration process tends to be lower (e.g. Eel in Figure 10 = 104 MWh with turbine efficiency of 40% compared to Ep = 110 MWh from Figure 9) than exclusive heat output (see concerns raised by BE).

However, if besides electric energy also heat resulting as an output of the turbine can be used this increases considerably the total output relevant for the calculation of the Ep. (Ep = Eel + Eheat)

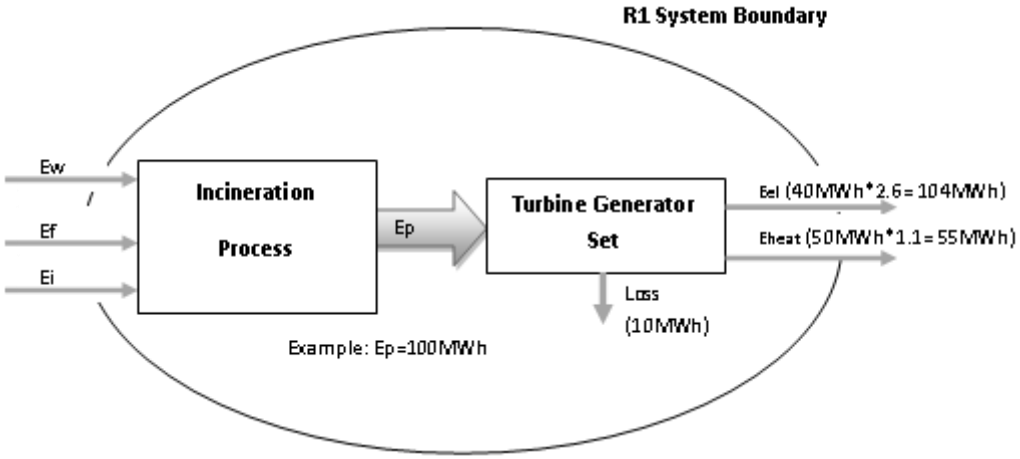

Figure 1-10: Ep in case of system boundary including turbine (exemplary figures)

In case of combined heat recovery and electricity production at the turbine leads the second alternative to a higher R1 result than alternative 1.

This approach is consistent with the mass flow (system boundaries) presented in the draft guidance provided by German authorities.

Consequently, in case of modern turbines, it is an advantage for operators to consider the turbine inside the system boundaries. Therefore clear guidance is required, when a turbine has to be considered as belonging to a third party. The answer on this question is provided within the permit of the plant.

If the turbine is not run by a third party the project team in line with the majority of stakeholders suggests voting for alternative two (consider turbine inside the system boundary), as it seems more logic from a technical point of view to have the turbine inside the system boundary. Another argument can be seen in the fact that the second alternative gives incentives to optimize the system. If the turbine is run by a third party it cannot be considered inside the system boundary.

In the following a review of regulation for an inclusion/separation of turbine and incineration unit in other EU legislation has been performed.

IPPC Directive 2008/1/EC defines “installation as follows:

’Installation’ means a stationary technical unit where one or more activities listed in Annex I are carried out, and any other directly associated activities which have a technical connection with the activities carried out on that site and which could have an effect on emissions and pollution;”

Hence this Directive foresees in principle the possibility to divide or unit an existing installation.

Whether the obligation to apply BAT prevents or reduces the risk to separate the electricity production from other process steps of the MSWI plant will be investigated at a later stage.

Q10: How are backflows of generated energies to be calculated?

Backflows are energy flows that come back from the external customer in a closed circuit, e.g. steam coming back from district heating or a power plant. The calculation of backflows is a problematic but important issue to decide. Comments are controversial.

According to CEWEP-ESWET-FEAD the backflows must in general be deducted from Ep. Austria requests that the backflows should be included in Ei. When they are included in Ei it must be made sure that they are evaluated equally to Ep (multiplied with factors 2,6 or 1,1 respectively), there should no differentiations be made according to the reason for the backflow.

On the other hand Belgium states that this amount of energy should not be included in Ei, as long as Ep (energy produced) is correctly calculated (see next sentence). The steam that is coming back is simply reheated by the waste incineration plant and it is this additional heat that should be taken into account for Ep.

According to the UK respondents backflows should be calculated by the heat content and the rate of backflow of the fluid.

According to the OVAM study it is relevant to decide whether the energy that is left in the returned condensate should be simply ignored **OR** included in Ei **OR** calculated using the difference between

outgoing and returning streams. As a consequence of these decisions energy efficiency factor varies: +/- 0.05 (see scenario 4).

In this context an exemplary case of a Swedish plant found in the BREF document for waste incineration should be discussed. It shows the interrelationship of return water temperature and additional energy recovered. In case the return water temperature is 40°C (the normal case for the particular Swedish plant but very low in comparison with the majority of European climates) 14% additional energy is recovered in the condenser. In case the return water temperature is 50°C only about 7% additional energy is recovered. In extreme cases, when the return water temperature is 60°C, no extra heat is recovered.

The project team shares the opinion that in general the backflows should be deducted from Ep or included in Ei, even more as the impact on R1 seems to be limited. On the other hand it has been stressed by a competent expert that incineration facilities should not be punished for taking back heat from third parties, as the operators are not necessarily in control of what comes back to the facility.

Hence the practical consequences of the interpretation should be further investigated and discussed.

1.3 R1 formula: Ef

Q 11: What is the definition of fuels?

Q 12: Only non-waste fuels (RDF and waste-oils)?

In general all stakeholders who have replied to this question (CEWEP-ESWET-FEAD, Germany, Austria, Belgium and UK) define fuels as “non wastes” (normally oil and gas).

According to the BREF document for waste incineration fuel is defined as follows:

(e.g. diesel, natural gas): for start-up and shutdown, to maintain required temperatures with lower CV wastes and for flue-gas reheating before treatment or release.

<u>An evaluation of existing legislation leads for the following results for waste-oil.</u>

General ban of using waste oils as fuel?

Article 21 of new WFD is the relevant provision concerning waste oils. Article 21 does not contain a ban of using waste oils as fuels; the priority to regeneration of waste oils before combustion has not been introduced into new WFD.

Waste oils as hazardous waste?

Waste oils are included in EWC Decision 2000/532/EC in chapter 13. All entries of this chapter are marked with an asterisk and, thus, considered as hazardous waste. Depending on origin and composition of the waste oils, other list entries might be possible as well.

Waste oils within the WI Directive

Within Waste Incineration Directive 2000/76/EC, Article 3 No 2 excludes from provisions for hazardous waste:

(a) combustible liquid wastes including waste oils if the mass content of PAH, and PCP are below teh limit values set in relevant Community legislation; these wastes are not rendered hazardous by virtue of containing other constituents listed in Annex II to Directive 91/689/EEC and the net calorific value amounts to at least 30 MJ per kilogramme,

(b) any combustible liquid wastes which cannot cause, in the flue gas emissions other than those from gasoil or a higher concentration of emissions than those resulting from the combustion of gasoil

Use of waste oils in incineration facilities dedicated to the processing of municipal solid waste?

Whether waste oils can be used as fuel in an incineration facility for municipal solid waste, has to be determined alongside the definition of the term “municipal solid waste” (see below).

The BREF Document for Waste Incineration (August 2006) lists RDF-refuse derived fuels under incinerator input wastes. This can be considered as a clear signal that RDF and waste oils are regarded as waste inputs for an incineration facility.

The project team supports the definition of fuels as non-waste and recommends that additionally a clear definition of “non wastes” is provided. This question is closely linked to end-of-waste status. Consequently, products which reached end-of-waste status cannot be calculated as Ew.

In the case of waste oils and RDF all stakeholders agree that these should be regarded as waste and therefore counted as Ew and not Ef. RDF in addition is listed in the BREF as waste. Waste oil is mentioned in the WI Directive as potential input material. In this context it should be clarified whether this interpretation implies that RDF and waste oil never can reach end-of-waste status in consequence?

From the point of view of common sense it in addition is defined that all in feed material entering the facility via the grate should be accounted as waste.

What remains to be clarified is the question whether in practice waste oil would be allowed at all to be used in a MSWI as secondary fuel.

Q 13 How does one determine the moment fuel contributes to steam production?

This question has to be answered together with question Q14. As regards this question, different stakeholder responses exist.

Following CEWEP-ESWET-FEAD and Germany, the process starts generally when the steam generator is connected to the steam grid and lasts until the legal minimum flue gas temperature is reached when the burner(s) is (are) shut down. The UK stipulates that it should be from the time that the fuel burners are switched on because even though there may be no steam generation but the heating of the boiler water starts which is the first stage of steam production. This should be verified case by

case. Belgium concludes that situations as they occur in practice are so diverse, that it would be impossible to describe in detail how to calculate this in an interpretation guideline.

According to OVAM, the most correct approach is to measure the fuel used before and after connection to the stream circuit. It can be distinguished between the case in which all the natural gas is seen as Ef and the case in which the natural gas for start up and shut down is ignored. The R1 energy efficiency factor would be higher in the second scenario.

According to the CEWEP Energy Report II, the imported energy with steam production (or hot water) is Ef, whereas the imported energy without steam production is Ei.

Examples for Ef are the fuel for start up (second phase when steam is produced), fuel for keeping temperature >850°C by using auxiliary burners or fuels for increasing the energy input (by additional coal, unpolluted wood etc.).

Examples of Ei are imported electricity, fuel for re-heating flue gases before SCR process or fuel for startup situations (first phase before steam is produced and connected with the grid).

Furthermore, CEWEP highlights the importance to distinguish between WtE plants producing only heat, plants producing only electricity and CHP. If only heat is produced the total electricity demand has to be imported, which could be 10 or rather 20 times higher than for a plant only producing electricity or CHP.

The project team shares the opinion that from a technical understanding and from the point of view of the energy balance steam production starts with the heating of water. Therefore, the natural gas for start up and shut down should not be ignored like in the second case

1.4 R1 formula: Ei

Q14: How to make a distinction between Ef and Ei?

According to the new WFD Ei means annual energy imported excluding Ew and Ef (GJ/year).

Austria claims that all fuel incinerated in the plant should count as Ef.

France, Germany and CEWP/ESWT/FEAD state that Ef is energy consumed when there is steam production (or hot water)and Ei the energy consumed without production of steam.

FR propose to apply a ratio of 50/50 when the distinction between Ef and Ei is not possible. NL recommends this a a general rule. For UK respondents the distinction between Ef and Ei is not a problematic issue, however, no further explanations have been provided.

OVAM highlights the importance to initially decide which amount of energy is contributing to steam production (Ef), and which amount is not (Ei). Dependent on this decision significant variations in energy efficiency of +/- 0.13 occur with higher R1 factor if input is calculated as Ei (compare Scenarios 7 and 8).

OVAM Scenarios:

In scenario 7 it is assumed that commercial waste and sludge need to be considered as auxiliary fuels. Therefore, energy contained in the fractions commercial waste and sludge is included in the parameter Ef.

In scenario 8 it is assumed that commercial waste and sludge are regarded as other sources of energy included in parameter Ei.

Examples for Ef are the fuel for start up (second phase when steam is produced), fuel for keeping temperature >850°C by using auxiliary burners or fuels for increasing the energy input (by additional coal, unpolluted wood etc.). Examples of Ei are imported electricity, fuel for re-heating flue gases before SCR process or fuel for startup situations (first phase before steam is produced and connected with the grid).

Ei is e.g. the imported amounts of energy for the maintenance of the co-firing system during start-up and shut down processes (before connecting to steam grid), the energy for the re-heating of the flue-gas for catalysts or after the washing systems (e.g. with gas or oil) as well as used extra-energies for the plant, which are not used for steam and hot water production.

CEWEP highlights the importance to distinguish between WtE plants producing only heat, plants producing only electricity and CHP. If only heat is produced the total electricity demand has to be imported, which could be 10 or rather 20 times higher than for a plant only producing electricity or CHP. CEWEP further concludes that the demand for imported energy Ei is significantly reduced in WtE plants, which use self produced heat (e.g. steam) instead of primary fuel for flue gas re-heating before the SCR-process.

An exemplary calculation provided in the draft guidance of Germany Ei is roughly one sixth in comparison to Ef.

According to the BREF document allocation of fuels in an incineration plant is as follow:

i. ensure that the required combustion chamber temperatures are maintained (**contributes to steam production**)
ii. increase the temperature in the combustion chamber to the required level before the plant is fed with waste (**contributes partially to steam production**)
iii. increase the flue-gas temperature (e.g. after wet scrubbers) in order to avoid bag house filter and stack corrosion, and to suppress plume visibility (no steam production)
iv. preheat the combustion air (no steam production)
v. heat-up the flue-gas for treatment in specific devices, such as SCR or fabric filters (no steam production).

The shares of steam and non steam production from fuels are reported as:

a. steam production (typically around 50 – 70 % of the additional fuel usage)
b. no steam production (the remaining 30 – 50 % auxiliary fuel use)

Taking in consideration the importance of the decision (+/- 0.13), the fact that in practice Ef seems to be dominating, and for reasons of practicability a complete calculation as Ef might be recommendable. However, it can be doubted whether the legislators had included an Ei into the calculation formula in this case. The approach suggested by CEWEP seems to be the second ambitious option in this case. It has to be clarified if in practice data can be provided sufficiently by operators. The application of the 50/50 solutions seems to be less favorable at the moment.

Due to the importance of the issue, further arguments, impacts and implications however, should be discussed.

Q 15: Should incoming electricity and heat flows be calculated with the factor 2.6 and 1.1?

CEWEP-ESWET-FEAD, Austria, Germany and UK state that electricity and heat flows be calculated with the factor 2.6 and 1.1. On the contrary Belgium states that incoming electricity and heat flows should not be multiplied by 2.6 or 1.1 due to the lack of legal basis.

This question has already been answered in Q 5. *From a technical point of view we share the opinion of stakeholders that incoming electricity and heat flows should be calculated with the factor 2.6 and 1.1 respectively. Otherwise any plant could easily raise its R1 value by importing and then exporting significant amounts of electricity and heat. However, the Belgium argument on the legal base has to be checked carefully.*

Q 16: How to account return flows from internal and external users?

This question seems to be both linked to the question of backflows and third users has already been answered in questions Q7, Q8 and Q9.

Return flows have to be deducted from Ep or to be included in Ei (CEWEP-ESWET-FEAD, Austria). Belgium argues that as far as Ep is correctly calculated the amount of energy should not be included in the factor Ei. The steam that is coming back is simply reheated by the waste incineration plant and it is this additional heat that should be taken into account for Ep. UK's response highlights the importance to agree if the internal use of energy is to be included in Ep.

The project team is inclined to share the opinion that in general the backflows should be deducted from Ep or included in Ei, even more as the impact on R1 seems to be limited. On the other hand it has been stressed by a competent expert that incineration facilities should not be punished for taking back heat from third parties, as the operators are not necessarily in control of what comes back to the facility and the lack of control over the processes has to be taken into account.

Hence the practical consequences of the interpretation should be further investigated and discussed.

Q 17: Should circulating heat and electricity for self-consumption be calculated as Ei?

This question is closely linked to the definition of Ep and Ei and has in general already been answered in questions Q4.

Circulating heat and electricity for self-consumption should be part of Ep according to CEWEP-ESWET-FEAD. For Austria it is essential that self consumption is taken into account in the R1 formula as Ei. For UK it is first of all important to decide what is included in Ep.

The project team recommends that energy that is used by the incineration plant (for various purposes inside the system boundary) is calculated as part of Ep (= gross energy production). This is in line with the view of the majority of stakeholders and existing guidance. What still needs to be clarified is whether the part of Ep used for self –consumption is also to be counted as Ei or not. The question needs further clarification and is to be answered together with the definition of system boundaries.

1.5 R1 formula: Ew

Q 19: Is only municipal waste to be considered in Ew and all other wastes as Ef or Ei?

According to Stakeholder opinion all waste flow is to be counted as Ew. In general it is impossible to identify the amount of energy coming from the different waste flows (CEWEP-ESWET-FEAD, Austria). Where the main purpose of the plant is primarily the processing of municipal solid waste, all other wastes should be included in Ew. In Austria's point of view all waste types should be considered as Ew. The UK has the opinion that if the main purpose of the plant is primarily the processing of municipal solid waste, all other wastes should be included in Ew.

This question is closely linked to the definition of Ef and Ew and also strongly relates to the questions in chapter 1.7. "scope of the R1 formula. Consequently the opinion of the project team to this question is the same as to the previous and subsequent questions. It is suggested to delete this question at a later stage.

Q 18: Ew to be calculated on the basis of the net caloric value (NCV)?
Q 30: How should Ew net calorific value be measured?

According to Austria, the best method for the NCV is a calculation with proofed process data over longer time periods (energy balances). France recommends keeping consistent with the system chosen, Ew has to be calculated for waste entering the system, which means after pre-treatment, if in place. Netherlands argues that it is nearly impossible to analyze the energy content based on sampling of the waste. The amount of the waste to be sampled for a reliable outcome is too high. Therefore energy content should be based on the energy balance of the incinerator.

Germany proposes the use of the BREF calculation formula NCV = (1.133 * (mst waste/mwaste) * cst x + 0.008 * Tb)/1.085 [GJ/Mg(tonne) waste].

The proper assessment of the NCV is a crucial element for the guidance as it could influence the R1 results significantly. Underestimating the NCV according to OVAM calculations leads to higher energy efficiencies.

OVAM scenarios 3 and 14:

Keeping all E- parameters identical and only varying the NCV of the waste Ew, the following difference in R1 factor was observed:

1. With a NCV of 10.500 kJ/kg (scenario 14) the resulting R1 factor was 0,575.
2. With a NCV of 9.700 kJ/kg (scenario 2), the energy efficiency factor was 0,608.

Sampling of waste is currently problematic due to the high inconsistency and variability of the material and diverging national rules.

The ideal situation would be an EU standard or an accepted regime for such measurements. Such an EU standard or regime is not in place yet, however, usually quite strict national requirements on measurement of NCV exist. Plants have developed detailed calculation models, adapted to their own specific situation, using different assumptions compared to the BREF. It could be interesting to compare these models with the results obtained using the BREF formula. Additionally, analysis methods have been formulated (e.g. CMA methodology by VITO).

One possible solution could be to derive an EU-wide standard from existing national rules.

Another option would be to apply the CEWEP approach.

According to CEWEP, the energy input is always calculated by addition of the energy of the steam (or hot water) output (measurement of the steam flow, pressure and temperature which gives its enthalpy or when the condensate flow equals the steam flow, measurement of the condensate flow and of the steam and condensate temperature) and the energy losses, the main one being the energy in the flue gas (which is directly measure) and the other one being lump sums (agreed in national standards). The NCV is calculated by dividing this energy by the waste flow (NCV = Ew/Flow).

This could be a feasible approach as almost continuously data on weight input and energy output are at the disposition of operators. The approach is identical to the formula described in the BREF document *pg. 591.*

$$c = \text{lower NCV} = (1.133 \times (\text{mst w/m}) \times \text{cst x} + 0.008 \times \text{Tb})/1.085 \text{ (GJ/tonne waste)}$$

$$\text{with} \quad \text{mst w} = \text{mst x} - (\text{mf x}(\text{cf/cst x})\text{x} \text{ ^b})$$

mst w = amount of the produced steam out of waste in the corresponding time period to mst x e.g. per year (tonne/y)
mst x =total amount of the produced steam in a defined time period e.g. per year (tonne/y)
mf =amount of fuel with steam production (see Ef in checklist) in the corresponding time period to mst x e.g. per year (tonne/y)
m =amount of incinerated waste (see Ew in checklist) in a defined time period to mst x e.g. per

year (tonne/y)
cst x = net enthalpy of steam (enthalpy of steam minus enthalpy of boiler water) (GJ/tonne)
see e.g. VDI Steam Tables in general constant for every single plant
cf = net calorific value of fuel with steam production see table 1 (GJ/tonne)
Tb = temperature of flue-gas after boiler (at 4 – 12 % O2 in flue-gas) (°C)
0.008 = spec. energy content in flue-gas (GJ/tonne x °C)
1.133 and 1.085 = constant figures by regression equation
`b = efficiency of heat exchange (as approach 0.80)

The project team considers mass and energy balances with measured plant data as appropriate method and therefore suggests using the CEWEP approach as the basis for further work. This is in line with the stakeholder comments received. Critical comments received as regards the quality of the existing formula (NL) shall be taken into consideration by working towards an improved energy balance methodology.

1.6 Specification of the application of the R1 formula

Q 20: Should local climatic conditions been taken into account (WFD Art 38(1) 3rd sentence) and how could this be done?

Q 21: Should local conditions in outermost regions been taken into account (WFD Art 38(1) 4th sentence) and how could this be done?

According to most stakeholder comments local climatic condition (also in outermost regions) should be taken into account.

CEWEP-ESWET-FEAD states that it needs to be considered as it affects on the one hand the production of electricity and on the other hand the possibility to sell heat. For Austria there is no need of consideration. Belgium expresses that local climatic conditions can be taken into account and it would make sense from a technical perspective, however, this goes beyond a guideline that is only used for clarification purposes of what is now in the WFD. If climatic conditions are taken into account, for instance via the use of heating days, this should be decided upon in comitology with a qualified majority and with scrutiny of the EP. The French authority consequently supports the development of a specification in order to take into account climate and other local specificities. Also UK supports the consideration of local climatic conditions. One way in which this could be done is through an adjustment factor to be applied based on geographic banding – three bands spread across the north/south spectrum and derived from climate data.

Portugal developed a comprehensive methodology for the correction of R1 factor related to climate conditions. The methodology develop comprises three steps. 1-Step: calculation of the maximum climatic correction, no matter where a WtE plant is located in the EU. Portugal proposes the value of 0.11 for "R1clmax" based on the results from the CEWEP study and on the BREF WI BAT 62. 2-Step: calculation of the specific R1 correction according to local climatic data. It is proposed to use Heating Degree Days (HDD) to correct "R1clmax" according to local temperature as follows: R1cllocal =

[(HDDEU25-HDDlocal)/HDDEU25]*R1clmax. The third and the final step should be the application of R1cllocal as follows: R1 (with climate correction) = R1 (prior to climate correction) + R1cllocal.

The project team recommends building on and further developing this methodology in the preparation of a comitology decision.

1.7 Scope of the R1 formula

Exact definition of MSW as well as of the "facilities dedicated to the incineration of MSW" is an important precondition. It could be agreed that the formulation "dedicated to the incineration of MSW" does not exclusively mean dedicated for MSW. In practice there is commonly incineration of industrial residues not covered by EWC 20.

Q 22: What are facilities dedicated to the incineration of municipal waste (MWI)?

According to CEWEP this is dependent on the permit (national authorities). Co-incineration plants, dedicated hazardous incineration plants, dedicated industrial waste incineration plants are excluded of the scope (AT, BE, FR). CEWEP further defines "Incineration facilities dedicated to the processing of municipal solid waste" as those recognized as such by a competent authority, usually in the permit even if they process other waste feeds at the same time as MSW or even exclusively during certain periods. Besides, it is stated that plants burning RDF or other recovery fuels derived from waste including municipal solid waste are within the scope of the R1 formula.

UK's definition goes further and defines facilities dedicated to the incineration of municipal waste as plants in which municipal solid waste or similar wastes are incinerated to generate power (not material products) and the energy released from municipal solid waste or similar waste burning in the process constitutes large portions (say, at least over 80% of the total energy release).

MSWI which apart from MW incinerate other wastes are in the scope. MSW and similar should be the largest part of the input (CEWEP-ESWET-FEAD). According to Austria these are still in the scope, because the wording "dedicated to the processing of municipal solid waste" in the R1 formula does not mean "exclusively dedicated to municipal solid waste".

Q 23: Municipal waste (MW): a) Defined in Chapter 20 of the List of Waste (2000/532/EC)? b) Including also pre-treated municipal waste from chapter 19 of the List of Waste (RDF)? c) Defined in Art 3(3) of directive 2000/76/EC on the incineration of waste?

Q 24: Are MWI which apart from MW incinerate other wastes not in the scope of the R1 formula? Should municipal waste be the largest part of the input of the MWI?

According to CEWEP-ESWET-FEAD the Definition of MSW can be best derived the WI Directive and the List of Waste. thus MSW means waste from households as well as commercial, industrial and institutional waste which, because of its nature and composition, is similar to waste from households.

Austrian suggests that the R1 formula refers to municipal solid waste, as specified in chapter 20 including output from waste treatment operations that not substantially alter mixed MSW properties. As regards inclusion of RDF, the formula should only be applicable if also chapter 20 wastes are covered by the permit. Separately collected fractions should not be in the scope of the R1 formula. Besides, this waste has to be solid.

UK's states that all other wastes should be included (e.g. solid recovered fuel (SRF) and waste wood), if the main purpose of the plant is primarily the processing of municipal solid waste. Then.

- Waste Incineration Directive

Article 3 No 3 of the Waste Incineration Directive 2000/76/EC, introduces the following definition of municipal waste to be treated:

'mixed municipal waste' means waste from households as well as commercial, industrial and institutional waste, which [...] is similar to waste from households, but excluding fractions indicated in the Annex [...] under heading 20 01[3] that are collected separately at source and excluding the other wastes indicated under heading 20 02 [....].

Article 4(4) of Waste Incineration Directive lays down that "the permit granted by the competent authority for an incineration or co-incineration plant shall, in addition [...]: (a) list explicitly the categories of waste which may be treated".

- BREF Waste Incineration

The BREF Document for Waste Incineration (August 2006) includes in a list[4] of incinerator input wastes" such as "Mixed municipal solid waste", "Bulky waste", Waste similar to MSW", "Residual MSW after recycling operations", "Commercial waste", "Packaging waste", "RDF-refuse derived fuels", which can give an additional indication about practice conditions in MSWI plants.

Another indication related to the elaboration of the R1 efficiency limit that might give an additional indication of the type of plant experts had in mind can be derived from the BREF document p.197 giving the average efficiency of 50 CHP plants and 50 MSWI boilers.

As the WI Directive is the most relevant legislation for MSWI, it is quite clear that municipal waste means mixed household waste and similar waste collected together with mixed household waste. Based on this background it can be agreed that MSWI plants can incinerate other wastes apart from mixed MSW as long as the permit is in accordance with the WI Directive and the BREF document.

Q 25: Is each waste input into a MWI, which is classified as R1 to be regarded as recovered?

According to CEWEP-ESWET-FEAD in general each waste input into a MSWI, which is classified as R1 should be regarded as recovered, but a plant classified as R1, can also accept waste for disposal. This

[3] Decision 94/3/EC now EWC Decision 2000/532
[4] chapter 2.4.2.1, table 2.10

position is supported by UK stating that the answer is yes, if the plant's WFD permit specifies the wastes that can be processed in the plant. Belgium raises the concerns that it is very hard to make a distinction between low calorific waste that hardly contributes to energy production and high calorific waste. Therefore, all waste that is sent to a waste incinerator that is classified as R1, should be regarded as being recovered.

The Austrian answer to this question is no, because the R1 formula refers to municipal solid waste. The R1 formula derogates the definition of recovery and the waste hierarchy. A strictly literal interpretation of the text should be applied.

In practice waste input into an MSWI seems to be mixed of different fractions, being composed to the extent possible to assure an optimized combustion process.

On the basis of this practical aspect and in line with the position to Q24 the project team proposes to recommend a homogenous classification of all waste inputs into a plant classified as R1, as long the acceptable waste are specified in the permit in accordance with the WI Directive and the BREF document.

Q 26: Should certain waste be exempted? a) Non-municipal waste, b) Waste with a low calorific value (<6000 KJ/kg), c) Hazardous waste, d) Separately collected municipal waste (bio-waste, plastic, wood)

CEWEP-ESWET-FEAD recommends not exempting any waste in general, and is strongly against any criterion referring to the NCV of the waste. What is important is to recover as much as possible of the energy available in the waste and not to get waste with a high NCV. The inclusion/exclusion of hazardous waste is regarded as political decision. Separately collected waste should not be exempted, but this should be left as matter of the waste hierarchy. This opinion is supported by the UK, which states that it is not clear; on what basis certain types of municipal solid waste might be exempted.

Austria asks for an exemption of all mentioned waste types. For separately collected municipal waste (bio waste, plastics, wood) other recovery (or recycling) operations should be given preference.

German authorities question whether waste with a calorific value of <6,000 kJ/kg, e.g. C&D waste such as soils and stones, sludges with high water content) may be regarded as recovered.

In line with Q 24 the project team proposes for practical reasons to not generally exempt waste as long as the permit is in accordance with the WI Directive and the BREF document. It however supports the position of Austria and Germany that for separately collected fractions and low calorific value primarily other treatment options should be chosen, as long as being in line with life-cycle thinking.

Q 27: May other provisions of the WFD lead to restrictions in the application of the R1 formula? a) The recovery definition, b) The waste hierarchy, c) The requirements on the protection of health and environment (Art 13)

From the point of view of CEWEP-ESWET-FEAD there are no other provisions of the WFD that lead to additional restrictions in the application of the R1 formula.

This position is supported by the UK's view. The R1 is sufficient to distinguish recovery from disposal for a particular subset of operations. It is an elaboration of the recovery definition for the purpose of these operations; applying the formula tells you whether the recovery definition is met or not. The UK's understanding is that the R1 formula is a method of distinguishing recovery from disposal for MSWIs. Implementation of Article 4 should influence Member States towards the future building of MSWIs which meet the energy efficiency threshold; and influence the choice of treatment by incineration towards treatment in an incinerator which meets the threshold. As regards Art 13, UK shares the opinion that protection of the environment and human health is the basic requirement of all environmental legislation and applies equally to a plant which is R1 or D10.

Austrian expresses the opinion that by using the R1 formula the replacing purpose of the waste in not required anymore and needs no proof. The R1 formula stipulates an exception to the recovery definition. Therefore the application of the formula should be restricted only to municipal solid waste. In addition the R1 formula contradicts the waste hierarchy because a waste has to be classified as recovered, even if the requirements of the recovery definition are not fulfilled. Incineration which applies to the R1 formula is "upgraded" to the same level as other recovery operations, which fulfill the recovery definition. The waste hierarchy prioritizes "real" recovery operations. Due to the waste hierarchy and considering the possible environmental impact from waste to energy plants and especially their relevance with regard to climate change, MS must give priority in their legislation to re-use and recycling. In particular separated municipal waste should undergo other treatment options than R1-incineration.

The project team tends to support the position of the UK but suggests further discussion about the possibility and need to further concretise specify exemptions (see Q 26) due to waste hierarchy objectives.

1.8 Monitoring compliance with the R1 formula

Q 28:	*The energy efficiency is calculated on the basis of the annual performance regarding the factors of the formula. a) Existing plants? b) New plants?*
Q 32:	*Verification (independent expert)?*

Stakeholder to a large extent share similar opinions as regards monitoring.

- For existing plants it is recommended to conduct energy efficiency calculations annually, either based on operation data for the whole year or as data measured on a short period of time and then extrapolated to a typical year of normal operation as recommended by relevant stakeholders. It is further recommended to verify/validate the calculations by an independent party, such as public authority or a certification organization. Verifications should be conducted at agreed EU-wide frequency.

- In this context it still has to be agreed on how many measurements should be performed annually for averaging and whether the data from the preceding year should be accepted as a basis for the determination of the R1/D10 status.

- For new plants it is recommended to use design parameters to calculate the energy efficiency followed by performance test after commissioning.

Belgium concretizes requirements further and recommends using design parameters to calculate the energy efficiency of an installation under normal operating conditions so that the R1/D10 status can be determined for the first year of operation. After one year of operation, the E-parameters should be recalculated based on the actual conditions. After three years of operation, the calculation should be repeated based on the average performance of the past three years. From that moment on, recalculations should only be done after structural changes that have a significant effect on the energy efficiency. The R1/D10 status should be confirmed by the waste authority every year. This validation can be limited to checking whether any structural changes occurred during the past year (e.g. technical modification, change of customers, etc.). If not, the installation can keep its R1/D10 status without any recalculations. If there are changes, recalculations should be done as for new installations.

German authorities provided detailed information as regards monitoring. They propose to only use data from regular operation periods, based on operative data from the preceding 3 years. Averaging is recommended over a 3 years period to balance climatic variations. For new installations a calculation is foreseen on the basis of engineering data and energy treaties. The classification as R1 facility should be granted annually.

The project team agrees with the proposed approach of using operational data for existing plants averaged over a given time period, and to use external expert for verification at regular frequency (e.g. annually). For new plants design parameters might be used as a starting point being replaced by operational data as soon as starting operation.

Q 29: Revision of monitoring results?

New tests should be made if there is a significant change in the plant e.g. boiler change, Turbine Generator set change, new line, reduction in the energy supply to a contractor according to CEWEP-ESWET-FEAD and German authorities. The Austrian response highlights regular monitoring by an independent expert (e.g. certified body) every 3 years. However, the competent authority may initiate monitoring at any time. No answers from France, Netherland and the UK.

Regular vision of monitoring results is regarded as important prerequisite for the classification as R1, The project team tends to support the approach brought forward by Austria. The exact frequency could be further discussed

Q 30: How should Ew net calorific value (NCV) be measured? a) Sampling of waste, b) Other methods, alternative method could be boiler heat load (continuous monitoring)? instead of (annual) direct CV measurement of waste. Effects of the facility equipment on the results?

This question has been combined and addressed together with question 18.

The project team considers mass and energy balances with measured plant data as appropriate method and therefore suggests using the CEWEP approach as the basis for further work. This is in line with the stakeholder comments received. Critical comments received as regards the quality of the existing formula (NL) shall be taken into consideration by working towards an improved energy balance methodology.

Q 31: Transitional period, when efficiency is not achieved due to decrease of energy consumption by third parties?

Short time decrease of energy consumption should not be taken into consideration. However, in case of definitive closure of the energy consumer, a transitional period must be considered before a WtE Plant would not be allowed any more to account this energy consumption in the R1 calculation according to CEWEP-ESWET-FEAD. German authorities suggest to base the status on data from three years thus implicitly allowing for a certain “transitional” period for a MSWI plant. For a decrease of energy consumption by third parties, no exemption should be granted to a plant when determining the R1 value according to Austrian representatives. In the UK’s view activities of third parties must not impact on a MSWI’S R1 classification (e.g. insolvency of heat host). This is a problem with the formula as discussed under general points at the start of the questionnaire response. No answers received from other stakeholders.

The project team is in favor of not taking into account short time decreases of energy consumption.

Q 33: How shall information on R1 status be communicated concerning transboundary shipments?

The receiving plant should be able to show that it has a permit as an R1 plant before a transboundary shipment. It might be a good idea to develop an electronic application where incineration operators should submit their data, as proposed by the Austrian respondents. The Commission should make the data available to the public. Germany stated that it needs to be further discussed whether the authority of dispatch shall take into account the R1 classification of receiving plants in its decision.

In addition AT asks for an amendment of Art 12(2) of the WI Directive, requesting reporting of relevant information for R1 in the annual report.

A valid permit is a prerequisite for transboundary movement. The procedural requirements of the waste shipment regulation should apply for R1 MSWI as for any other facility.

Further issues which require guidance (expressed by stakeholders):

In addition to the questions above, Austria proposed that it should be an issue for guidance, whether the principle of self-sufficiency and proximity (Art 16§1 WFD) is applicable on all wastes destined to incinerators that are classified as recovery. It should be avoided that wastes that are currently incinerated in other plants (e.g. incinerators for hazardous waste) are directed to R1-incinerators.