

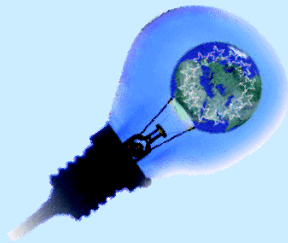


5th CEWEP Congress on  
Waste-to-Energy 2010  
30 June to 2 July, in Antwerp



# The R1- Formula

## an energy efficiency criterion for Municipal Waste Incinerators



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- **R1-formula: Where does it come from?**
- **What is it ?**
- **E.U. Guideline in progress**
- **Statistics & Pending matters**
- **Key issues & Consequences**

# R1 ? Where does it come from ?

- In fact R1/D10

- R1 : Recovery One
- D10 : Disposal Ten

- As clever as R2-D2 ?

# Original Framework directive (1975)

- **First Waste Framework directive (CEE/75/442)**
  - At that time  
Disposal **meant any treatment,  
including**  
the Recovery of resources  
(& the Collection of waste)

# 1<sup>st</sup> Revision of the Framework directive (1991 & 1996)

- **1991 : Revision of the Framework directive (CEE/91/156)**

- Disposal → Double meaning
  - ✓ Disposal **different of** Recovery (Art. 4 ,7, 8,12)
  - ✓ Disposal = Treatment (Art. 15)
- New Annexes IIA & IIB
  - ✓ Disposal operations
  - ✓ Operations which **may lead to Recovery**

- **1996 : Commission Decision (96/350/EC)**

- ✓ Renamed the 2 Annexes, which became
  - » **Disposal Operations**
  - » **Recovery Operations**  
(instead of “which **may lead to recovery**”)

⇒ **Black OR White !!!**

A problem is that most treatment operations are neither 100% recovery nor 100% disposal



# How the R & D issue became a customs officer Yes/No question



- **Transboundary shipment regulation**

Last version : Council Regulation (EC) No 1013/2006

- **Member States can oppose waste transboundary shipments**

- **Easily** if shipped towards a **Disposal Operation**
- **With difficulty or cannot** if towards a **Recovery Operation**

- **Such a dichotomous question was a source of numerous problems**



# R1 or D10 ?

## ANNEX I DISPOSAL OPERATIONS

- D 1 Deposit into or on to land (e.g. landfill, etc.)
- D 2 Land treatment (e.g. biodegradation of liquid or sludgy discards in soils, etc.)
- D 3 Deep injection (e.g. injection of pumpable discards into wells, salt domes or rock caverns, etc.)
- D 4 Surface impoundment (e.g. placement of liquid or sludgy discards into pits, ponds or lagoons, etc.)
- D 5 Specially engineered landfill (e.g. placement into lined discrete cells which are capped and isolated from one another and the environment, etc.)
- D 6 Release into a water body except seas/oceans
- D 7 Release to seas/oceans including sea-bed insertion
- D 8 Biological treatment not specified elsewhere in this Annex which results in final compounds or mixtures which are discarded by means of any of the operations numbered D 1 to D 12
- D 9 Physico-chemical treatment not specified elsewhere in this Annex which results in final compounds or mixtures which are discarded by means of any of the operations numbered D 1 to D 12 (e.g. evaporation, drying, calcination, etc.)
- D 10 Incineration on land**
- D 11 Incineration at sea (\*)
- D 12 Permanent storage (e.g. emplacement of containers in a mine, etc.)
- D 13 Blending or mixing prior to submission to any of the operations numbered D 1 to D 12 (\*\*)
- D 14 Repackaging prior to submission to any of the operations numbered D 1 to D 13
- D 15 Storage pending any of the operations numbered D 1 to D 14 (excluding temporary storage, pending collection, on the site where the waste is produced) (\*\*\*)

## ANNEX II RECOVERY OPERATIONS

- R 1 Use principally as a fuel or other means to generate energy (\*)**
- R 2 Solvent reclamation/regeneration
- R 3 Recycling/reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes) (\*\*)
- R 4 Recycling/reclamation of metals and metal compounds
- R 5 Recycling/reclamation of other inorganic materials (\*\*\*)
- R 6 Regeneration of acids or bases
- R 7 Recovery of components used for pollution abatement
- R 8 Recovery of components from catalysts
- R 9 Oil re-refining or other reuses of oil
- R 10 Land treatment resulting in benefit to agriculture or ecological improvement
- R 11 Use of waste obtained from any of the operations numbered R 1 to R 10
- R 12 Exchange of waste for submission to any of the operations numbered R 1 to R 11 (\*\*\*)
- R 13 Storage of waste pending any of the operations numbered R 1 to R 12 (excluding temporary storage, pending collection, on the site where the waste is produced) (\*\*\*\*)

● Incineration can be either R1 or D10

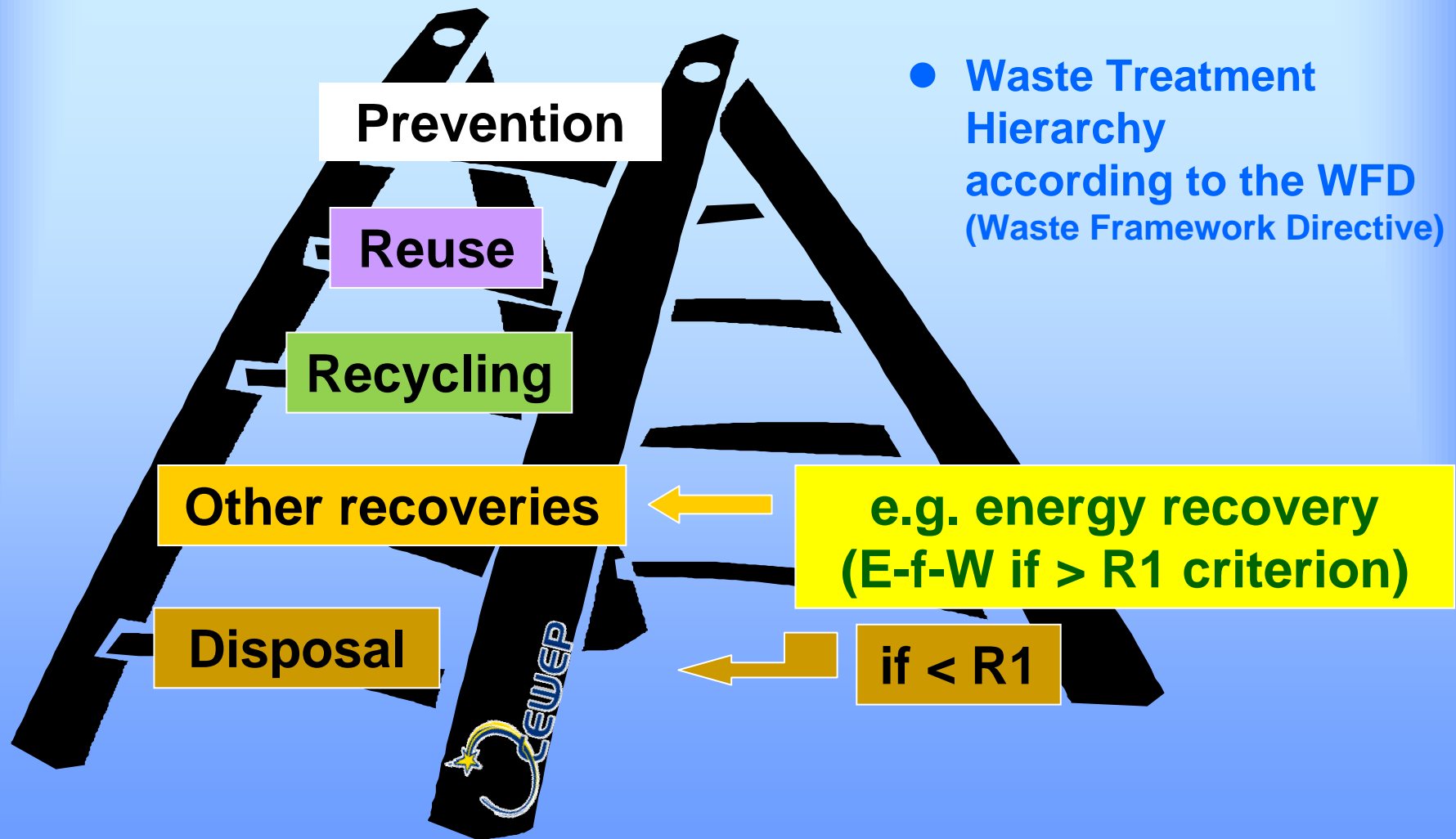
# European Court of Justice (ECJ) judgements in 2/2003

- 2 cases initiated by the Commission
  - Against Germany (case C-228/00)
    - Waste shipped towards a cement kiln in Belgium
  - Against Luxemburg (case C-458/00)
    - Waste shipped towards a MW Incinerator in Strasburg
- Advocate General Jacobs followed by Court said
  - **'Use principally as a fuel' means** that 'the essential purpose of the operation is to enable waste to fulfil a useful function, namely the generation of energy'
  - Cement kiln : the essential objective is to produce cement and the waste is used in the purpose of generating energy
    - ⇒ It is a **R1 operation**
  - Incinerator : the principal objective of the operation is the disposal of waste !!!
    - ⇒ It is a **D10 operation !!!**



- **Dissatisfied**
  - Level playing field
  - Recovery rates
  - Waste hierarchy
- **Decided to introduce a criterion on the overall energy efficiency of the Waste-to-Energy**
- **And did it in the 2<sup>nd</sup> revision of the Waste Framework Directive (2008)**
  
- **That's how was born the R1-formula**

# Waste-to-Energy again recognized as a recovery operation



- Waste Treatment Hierarchy according to the WFD (Waste Framework Directive)

# R1 formula : What is it ?

**R1 ?**

DIRECTIVE 2008/98/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL  
of 19 November 2008  
on waste and repealing certain Directives

ANNEX II

RECOVERY OPERATIONS

R 1 Use principally as a fuel or other means to generate energy (\*)

$$\frac{E_p - (E_f + E_i)}{0.97 \times (E_w + E_f)}$$

(\*) This includes incineration facilities dedicated to the processing of municipal solid waste only where their energy efficiency is equal to or above:

- 0,60 for installations in operation and permitted in accordance with applicable Community legislation before 1 January 2009,
- 0,65 for installations permitted after 31 December 2008,

using the following formula:

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

In which:

E<sub>p</sub> 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)

E<sub>f</sub> means annual energy input to the system from fuels contributing to the production of steam (GJ/year)

E<sub>w</sub> means annual energy contained in the treated waste calculated using the net calorific value of the waste (GJ/year)

E<sub>i</sub> means annual energy imported excluding E<sub>w</sub> and E<sub>f</sub> (GJ/year)

0,97 is a factor accounting for energy losses due to bottom ash and radiation.

This formula shall be applied in accordance with the reference document on Best Available Techniques for waste incineration.

- The look and the taste of an energy efficiency
- Thermodynamically not correct
- With 'equivalence factors' (in ref. to primary energy)
  - 2.6 for electricity
  - 1.1 for heat
  - 1 for fuels
- Taking into account the **USE** of the energy and not only its recovery
  - (English uses a single word for
    - ✓ 'Recupération' ←
    - ✓ 'Valorisation' ←
- Not precise enough

# Guideline in progress





# E.U. Working Group & Program



- **25/6/2009: WG set up by the Commission (1<sup>st</sup> meeting)**
  - Commission & JRC (European 'Joint Research Center')
  - Members States representatives
  - Stakeholders (ESWET, CEWEP, FEAD)
- **Questionnaire** to participants on R1 clarifications (for 10/2009)
- **17/3/2010: 2<sup>nd</sup> meeting of WG + BiPro (& EEB)**  
(Consultant) (Ecologists)
- **11/5/2010: Draft Guideline** by the Commission
- **02/6/2010: Deadline for comments** on the draft guideline



## THEN

- **16/9/2010: TAC** (Technical Adaptation Committee)

# R1- formula

## Draft Guideline proposal

### Content

- **To Include**

- **Definitions**
- How to **calculate** the R1-formula
- **A procedure** to check the R1-status
- **Boundary limits** (with drawing)
- **List of energy to be counted** in  $E_p$ ,  $E_f$  and  $E_i$



# Main questions answered by the Guideline draft

- Scope : Which plants ? Which Waste ?
- Which Boundary limits ?
- $E_p$  : What is the 'Energy produced' ?
- $E_f$ ,  $E_i$ ,  $E_w$  : Which Energy inputs ?
- Where to measure ?
- How to qualify ?
- Special cases (New line, complex plant ...)

## Still to be done (separately)

- Local conditions compensation
  - Size? & Climate Factors

**ANNEX 1 to R1-  
formula guideline  
document:  
Flow diagram,  
boundary limits and  
measurements  
principles**

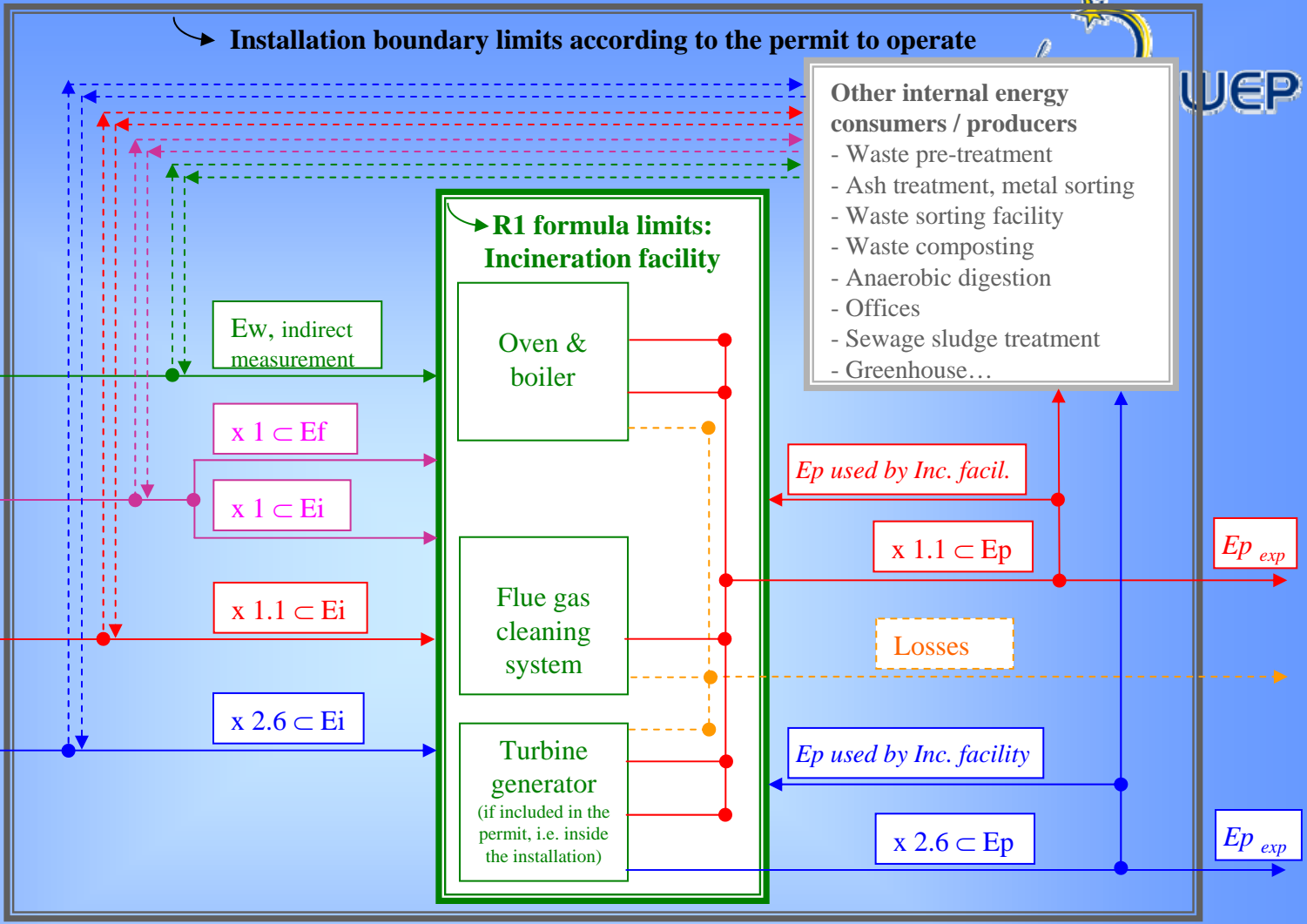
All waste including RDF

Fuel: oil, gas, coal

Other energy: Steam, hot water except the steam condensate which are deducted from  $E_p$

Electricity

Installation boundary limits according to the permit to operate



**DRAFT**


# Statistics

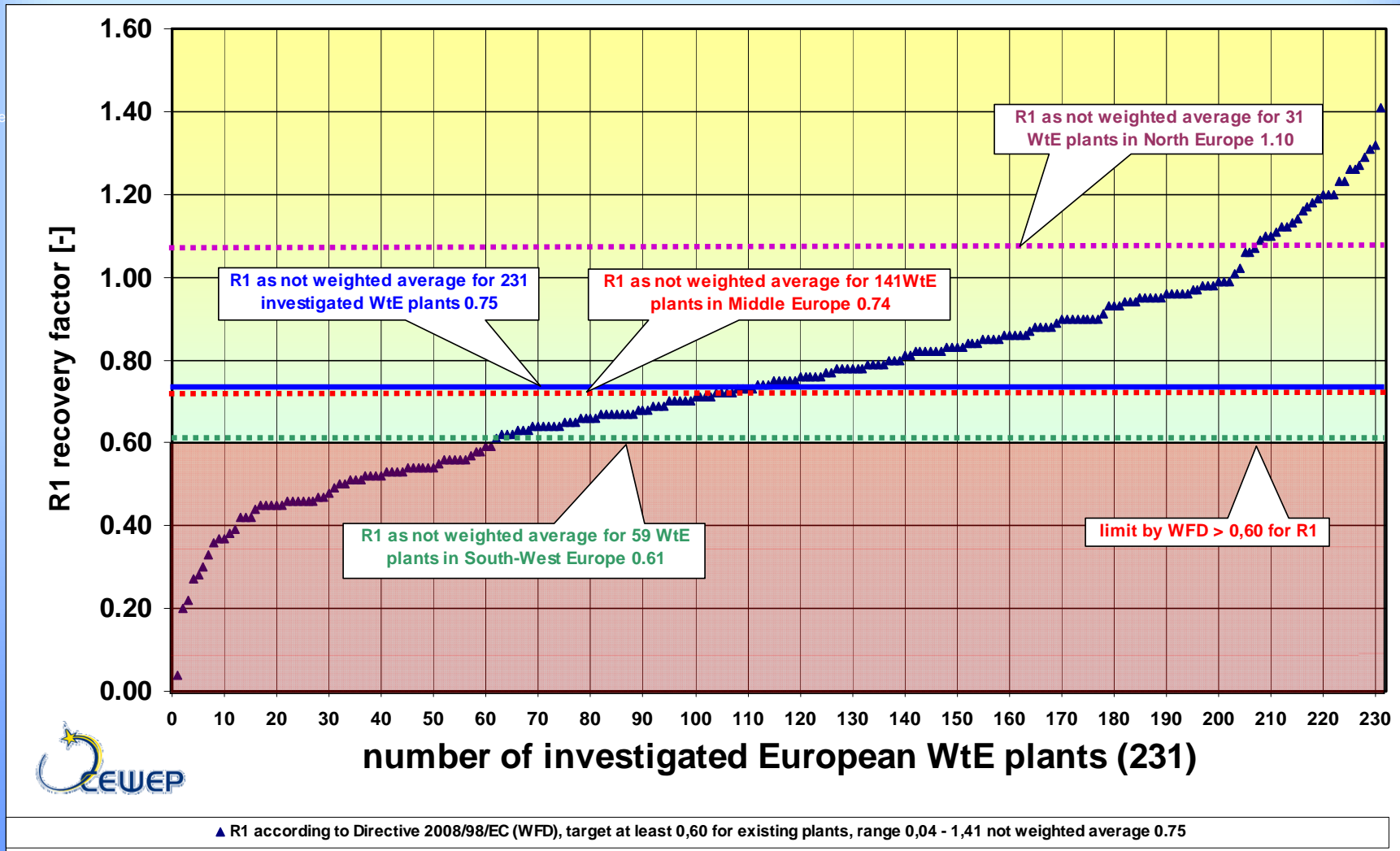




# R1 according to 3 x 3 categories and nr. of plants with R1 > 0.6

Kind of Energy
Plant size
Geographical region

| <br>R1 depending on different classifications | unit         | all investigated WtE plants | kind of energy recovery of a plant |                      |                | size (throughput) of a plant |                            |                   | geographical European region of a plant |               |              |
|--|--------------|-----------------------------|------------------------------------|----------------------|----------------|------------------------------|----------------------------|-------------------|---|---------------|--------------|
|  |              |                             | only electricity production        | only heat production | CHP production | < 100,000 Mg/year            | 100,000 to 250,000 Mg/year | > 250,000 Mg/year | South-West Europe                       | Middle Europe | North Europe |
| number of plants included  | n            | <b>231</b>                  | 75                                 | 41                   | 115            | 92                           | 77                         | 62                | 59                                      | 141           | 31           |
| total throughput of plants   | million Mg/a | <b>45.52</b>                | 12.72                              | 4.57                 | 28.23          | 5.34                         | 12.77                      | 27.41             | 8.08                                    | 32.13         | 5.31         |
| R1 result (averages not weighted)  | [-]          | <b>0.75</b>                 | <b>0.64</b>                        | <b>0.72</b>          | <b>0.84</b>    | <b>0.68</b>                  | <b>0.77</b>                | <b>0.85</b>       | <b>0.61</b>                             | <b>0.74</b>   | <b>1.10</b>  |
| R1 result (min-max)  | [-]          | 0.04-1.41                   | 0.12-0.98                          | 0.04-1.29            | 0.30-1.41      | 0.04-1.20                    | 0.12-1.41                  | 0.47-1.31         | 0.12-1.12                               | 0.04-1.29     | 0.88-1.41    |
| number of plants: R1 at least 0.60   | n (%)        | <b>169 (73.2)</b>           | 46 (61.3)                          | 25 (61.0)            | 98 (85.2)      | 50 (54.3)                    | 60 (77.9)                  | 59 (95.2)         | 24 (40.7)                               | 114 (80.9)    | 31 (100)     |
| number of plants: R1 under 0.60  | n (%)        | <b>62 (26.8)</b>            | 29 (38.7)                          | 16 (39.0)            | 17 (14.8)      | 42 (45.7)                    | 17 (22.1)                  | 3 (4.8)           | 35 (59.3)                               | 27 (19.1)     | 0 (0)        |



<sup>1)</sup> Calculation in accordance to the Directive 2008/98/EC (WFD) [2], ANNEX II, with equivalence factors for energy produced (export and self use) are for electricity 1MWh<sub>el</sub> = 2.6 MWh<sub>el</sub> equ and for heat 1MWh<sub>th</sub> = 11MWh<sub>th</sub> equ.

# Pending questions about the R1 formula

$$\frac{E_p - (E_f + E_i)}{0.97 \times (E_w + E_f)} \geq 0.6 \text{ (existing) or } 0.65 \text{ (new)}$$

- **Local conditions**  
can be taken into account (WFD, Art. 38)
  - Plant size
  - Geographical location
- Discussion apart from the Guideline document  
'Comitology procedure with scrutiny'



# Key issues & Consequences





# Key issues about the R1 formula

- R1 is not the energy efficiency of the plant, which is > 80%  
But the efficiency of the recovery by the plant  
and of it being used by clients (and the plant)
  - The R1 factor is not an efficiency in % (because of the equiv. factors)  
but a ratio to be expressed as a decimal figure: 0.60, 0.65
- Energy used by the plant is to be counted as ‘Produced’
  - The objective of a power plant is only to generate power  
whereas the objectives of an incinerator are
    - ✓ to treat the waste
    - ✓ AND to generate energy
- Much easier to comply with the R1 criterion  
when some heat is sold
  - (Equivalence factors of 2.6 and 1.1 are in favour of heat)

# R1 : Really an incentive

- **Everybody wants his plant to have the R1 status**
  - For new plants, it's a 'must' to be above 0.65:  
in EU as well as in most other countries
  - For existing plants, it's a challenge to reach 0.60:  
Studies everywhere to improve
    - » the use of heat
    - » the generation of electricity
- **In France, the new tax on incineration**  
(thanks to the 'Grenelle de l'Environnement' !!!)  
**can be reduced**  
**if the W-t-E plant has the R1 status**



# Further information ?



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# 'TGAP' rates

No more 'TGAP' for FGT residues in Haz. Landfill

Amendements votés par le sénat le 24 novembre 2008



| MODULATION DE LA TGAP EN €/T DANS  | 2009      | 2010      | 2011      | 2012      | 2013      | 2014      | 2015      |
|--|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| <b>SITES DE STOCKAGE</b>   |           |           |           |           |           |           |           |
| Non autorisés  | 50 €      | 60 €      | 70 €      | 100 €     | 100 €     | 100 €     | 150 €     |
| Autorisés  | 15 €      | 20 €      | 20 €      | 30 €      | 30 €      | 30 €      | 40 €      |
| A) Autorisés + ISO 14001   | 13 €      | 17 €      | 17 €      | 24 €      | 24 €      | 24 €      | 32 €      |
| B) Autorisée + Valorisation du biogaz > 75 %   | 10 €      | 11 €      | 11 €      | 15 €      | 15 €      | 20 €      | 20 €      |
| Base + A et B  | Pas prévu | Pas prévu | Pas prévu | Pas prévu | Pas prévu | Pas prévu | Pas prévu |
| Réduction pour T transférées par multimodal  | 0,5 €     | 0,6 €     | 0,6 €     | 0,7 €     | 0,8 €     | 0,9 €     | 1,0 €     |
| A compter du 1 <sup>er</sup> janvier 2016, les tarifs mentionnés sont relevés, chaque année, dans la même proportion que la limite supérieure de la première tranche du barème de l'impôt sur le revenu. |           |           |           |           |           |           |           |
| <b>SITES D'INCINERATION ET DE CO-INCINERATION</b>  |           |           |           |           |           |           |           |
| Base   | 7,00 €    | 7,00 €    | 11,20 €   | 11,20 €   | 14,00 €   |           |           |
| A) Base + ISO 14001  | 4,00 €    | 4,00 €    | 6,40 €    | 6,40 €    | 8,00 €    |           |           |
| B) Base + Efficacité énergétique fixée par arrêté  | 3,50 €    | 3,50 €    | 5,60 €    | 5,60 €    | 7,00 €    |           |           |
| C) Base + emission NOx < 80 mg/Nm3   | 3,50 €    | 3,50 €    | 5,60 €    | 5,60 €    | 7,00 €    |           |           |
| Base + A et B ou B et C ou A et C ou A et C  | 2,00 €    | 2,00 €    | 3,20 €    | 3,20 €    | 4,00 €    |           |           |
| Réduction pour T transférées par multimodal  | 0,50 €    | 0,50 €    | 0,80 €    | 0,80 €    | 1,00 €    |           |           |
| A compter du 1 <sup>er</sup> janvier 2014, les tarifs mentionnés sont relevés, chaque année, dans la même proportion que la limite supérieure de la première tranche du barème de l'impôt sur le revenu. |           |           |           |           |           |           |           |