



**«Optimal recovery of material and energy resources in the
context of waste management»**

Report of the Experts Seminar

9 December 2009 – Turin, Italy



Introduction

This experts seminar was organized in the framework of a partnership between ACR+ (www.acrplus.org) and Holcim (www.holcim.com). This partnership aims at feeding the debate and identifying the best practices in link with the optimal management of resources in the context of waste management policies. It intends to explore legal and technical solutions in link with multiple policy developments at international level, namely:

- at UN level: United Nations Environment Program (UNEP) / Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, Conference of the Parties (COP) Climate Change
- at EU level: new Waste Framework Directive, Post-Lisbon developments, EU 2020 objectives, new EU Framework Programme for the Environment and revision of several EU Strategies.

It is in direct link with the Resource Efficiency Alliance initiative (www.epe.be/Default.aspx?p=102&n=112).

Objectives and format of the seminar

This meeting will gather a group of experts in order to discuss the issue of building a balanced approach for material and energy resource recovery for different waste treatments alternatives such as recycling, incineration and co-processing solution topics. This aims to pave the way for the possible organization of an international Conference to be held during the Spanish Presidency of the EU (in May 2010). The participation in the seminar is limited and by invitation only.

This will be done taking into account the various aspects of the topic: climate change and CO2 balance, socio-economic aspects, etc., placing emphasis on best practices for some specific waste flows (residual household waste, tyres, Construction & demolition materials, Sewage sludge, incineration bottom ashes).

Each session will be introduced by several presentations in order to foster the debate. A maximum amount of time will be reserved for discussion.

The structure of this seminar was the following:

- **Introductory speeches:**
 - **Alternative resources management** ([Jean-Pierre Degré, HOLCIM](#))
 - **European waste management policy** ([Jean-Pierre Hannequart, ACR+](#))
- **Carbon balance of the different waste treatment options**
 - **Data from Oporto** ([Isabel Nogueira, Lipor and Rui Dinis, E.value Porto](#))
 - **LCA of Integrated Waste Management Systems** ([Prof. Gianandrea Blengini, Polytechnic Institute of Turin and Michele Bertolino, Legambiente](#))



- **The recovery of energy resources in the recycling processes**
 - Food Waste Collection and Anaerobic Digestion in UK (Ann Ballinger, EUNOMIA, UK)
 - Recovery of energy in the recycling processes (Francis Radermaker, Brussels Capital Region)-

- **The recovery of material resources in the energy recovery processes (incineration, co-processing and others)**
 - Waste co-processing in cement kilns, Raffaele Chiulli, EuroFuels S.p.A.
 - From waste to energy: the gas management system at Basse di Stura landfill in Turin, Fabrizio Bonnardel, AMIAT
 - A complete overview of the energy recovery from municipal waste in Italy Roberto Caggiano, Federambiente

- **Best practices for specific flows**
 - Construction materials, Christian J. Engelsen, SINTEF –
 - Residual household waste, Claudio Demaria and Carlo Zanotta, Ideagrande, Cuneo Province
 - Tyres, Gianni Rimondi, EcoPneus
 - Sewage sludge, Luis Carlos de Souza, Holcim
 - Incineration bottom ashes, Tom Mc Carthy, Resource Recovery

- **Debate and Conclusions**

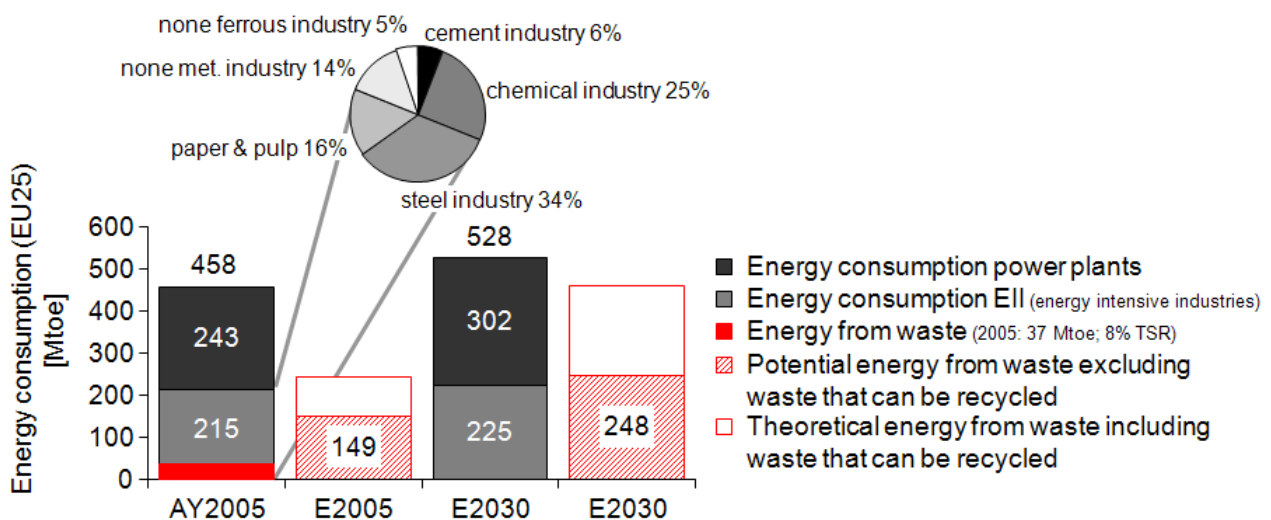
INTRODUCTORY SPEECHES

ALTERNATIVE RESOURCES MANAGEMENT (by Jean-Pierre DEGREGZ, HOLCIM)

The European Commission's proposed strategy suggests three pillars in its policy responses to the challenges of resources management:

- Better and undistorted access to raw materials on world markets;
- Improve conditions for raw materials extraction within Europe, and
- Reducing the EU's consumption of raw materials by increasing resource efficiency and recycling.

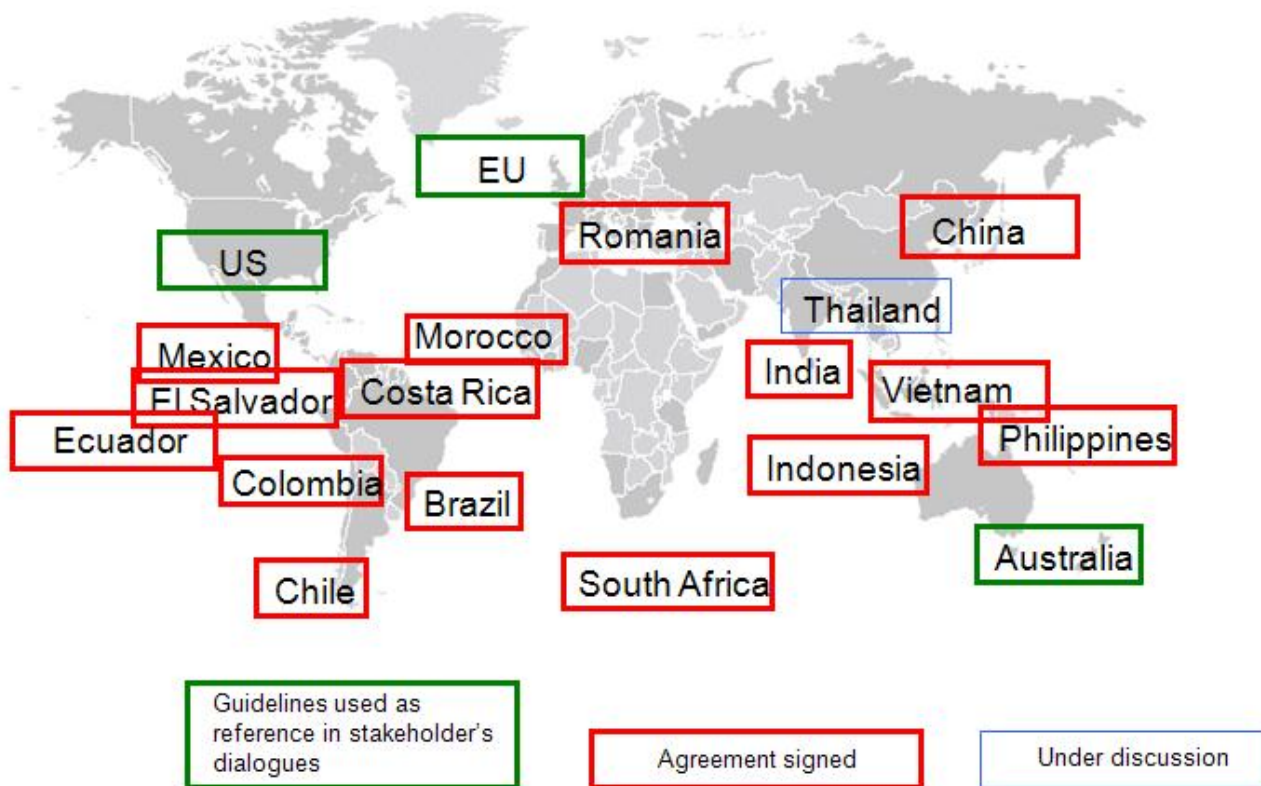
Current waste management practices leave a substantial part of the resource potential of waste unused. Estimates indicate that world-wide up to 8.5 billion tons of waste is discarded each year. Despite all the efforts to minimize waste, more than 80% is currently landfilled, dumped or burned illegally, contributing to pollution and not accessible for energy intensive industries.



Co-processing can be the solution for upgrading waste management within the waste hierarchy, reducing wastes health & environmental impacts, maintaining and improving

the industrial sector's competitiveness, decreasing the costs of waste management and improving all human and technical-economical factors.

Then the attention must go to Holcim's approach to sustainable development, which is a fundamental element of Holcim strategy, vision and mission. The next figure shows the countries that are in favour of the implementation of specific guidelines for co-processing:



It's interesting to notice what would happen with CO₂ emissions if the European cement industry would stop co-processing waste and biomass:

-Around 65 new waste incinerators would be needed in Europe to dispose of 6,5 million ton waste which is currently recovered in the cement industry.

-The direct emissions from cement production will increase:

13.6 % of energy to be sourced from fuel instead of fossil waste, at average emission factor of 93.5 instead of 79 kg CO₂/MJ = +1.3 Mton CO₂

4.1 % of energy to be sourced from fuel instead of biomass, at average emission factor of 93.5 instead of 0 kg CO₂/MJ = +2.5 Mton CO₂

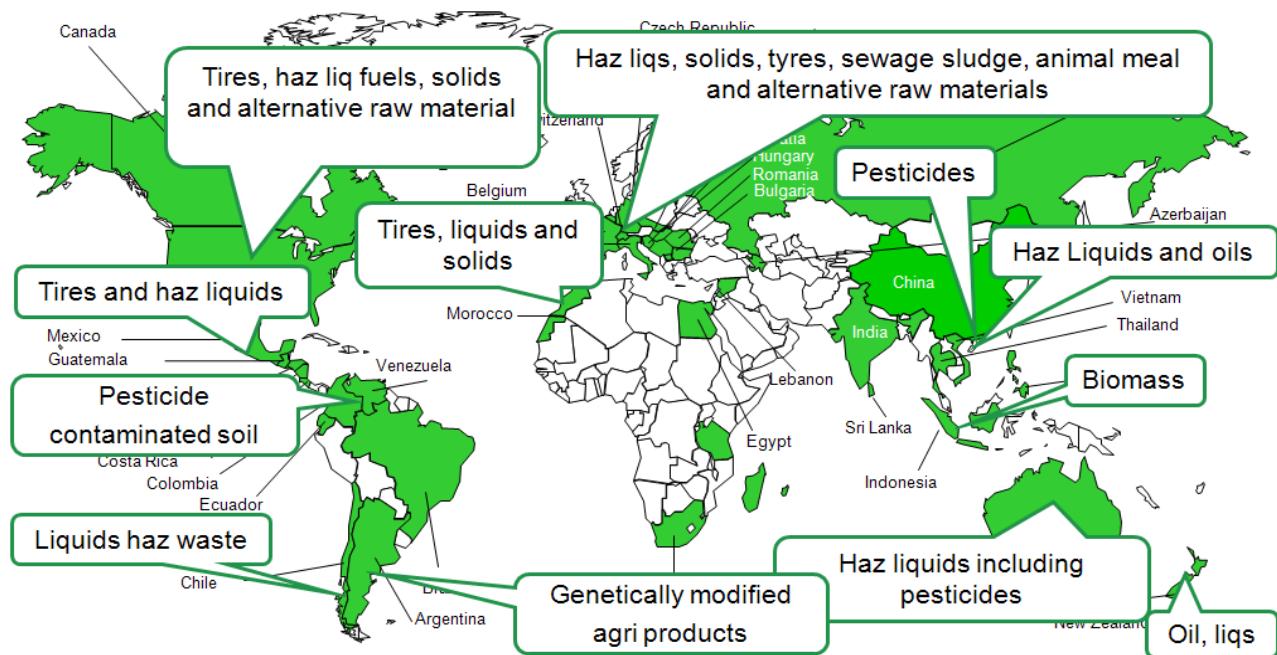
The emissions from waste disposal will increase:

Fossil waste to be incinerated, at average emission factor 79 kg CO₂/MJ = +7.2 Mton CO₂

Possibly methane from waste landfilling without biogas recovery

European absolute emissions will increase by 11 Mton CO₂ or 6.8 % of cement industry gross emissions

Below there are examples of AFRs and hazardous wastes co-processed or treated by Holcim.



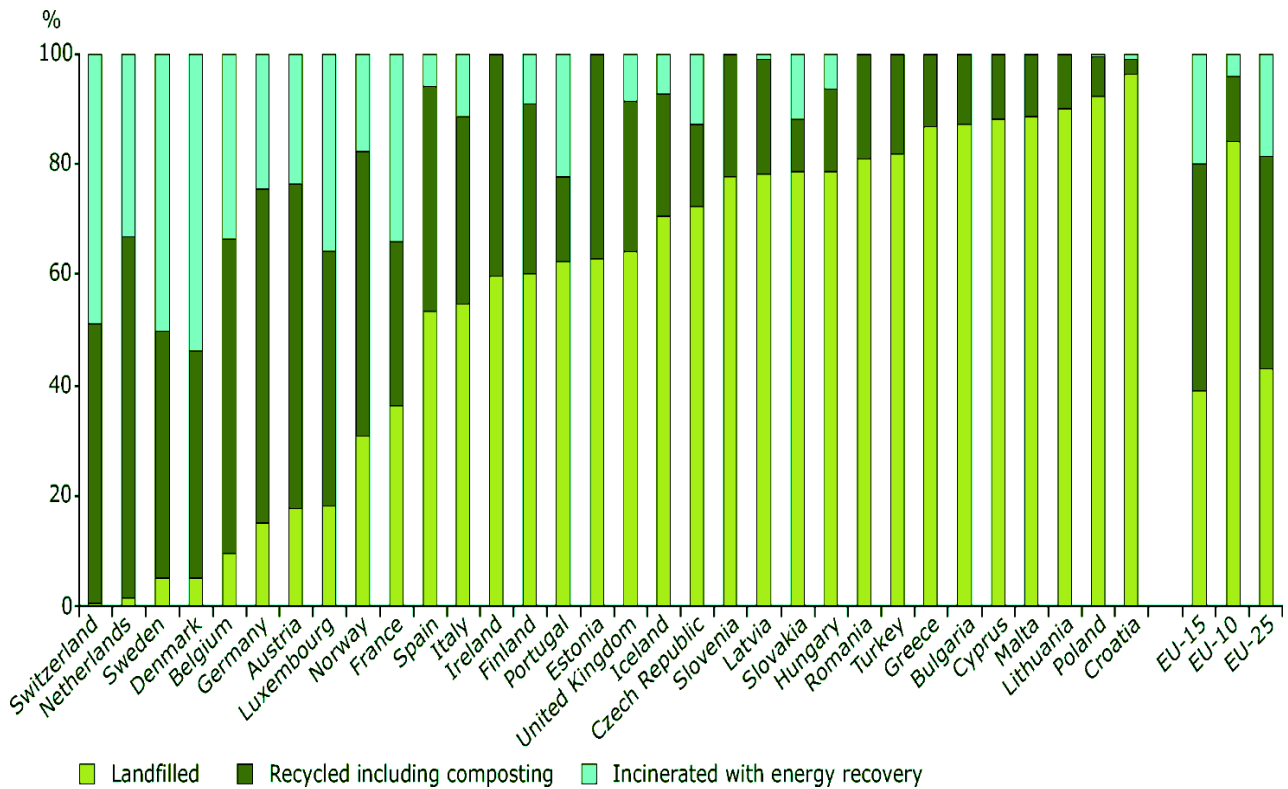
EUROPEAN WASTE MANAGEMENT (by Jean-Pierre HANNEQUART, ACR+)

The data available about municipal wastes management are not very clear. So , we have two list concerning the quantities which are produced (in kg/inh/year) from Eurostat and OECD:

<u>Denmark</u>	801.....740
Ireland	786..... 800
Cyprus	754.....
Luxembourg	694..... 680
Malta	652.....
Netherlands	630..... 625
Austria	597..... 585
Spain	588.....600
United Kingdom	572..... 585
Germany	564..... 565
Italy	550..... 550
France	541... ..535
Estonia	536.....
Sweden	518.....495
Finland	507.....495
Belgium	492.....480
Portugal	472.....445
Bulgaria	468.....
Hungary	456.....
Greece	448.....440
Slovenia	441.....
Lithuania	400.....
Romania	379.....
Latvia	377.....
Poland	322.....260
Slovakia	309.....280
<u>Czech Republic</u>	294.....300

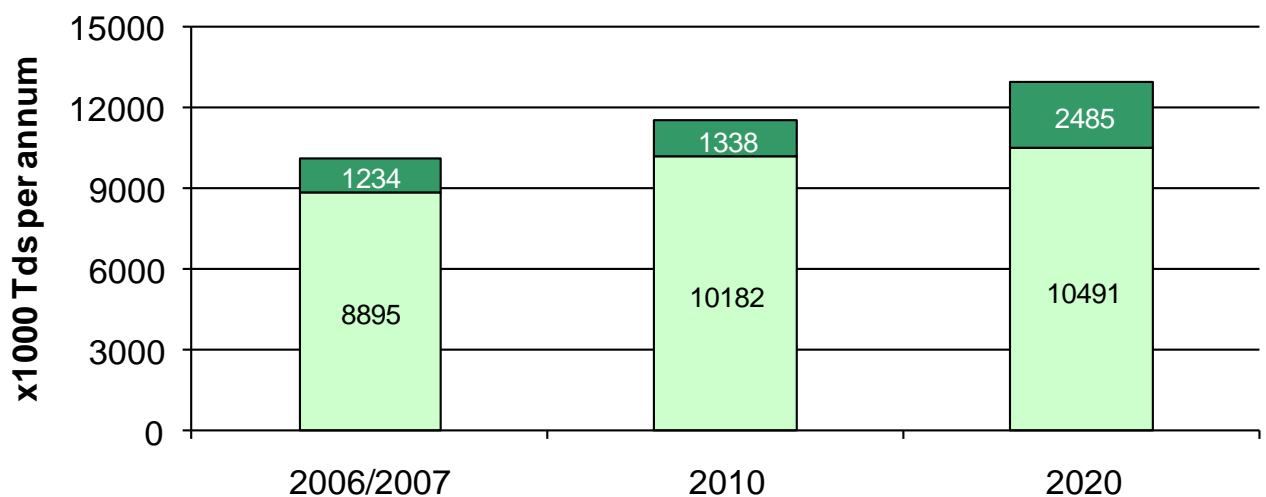
EUROSTAT O7 / OCDE O6

About the existing practices of waste treatment, the available data shows very important differences between countries:

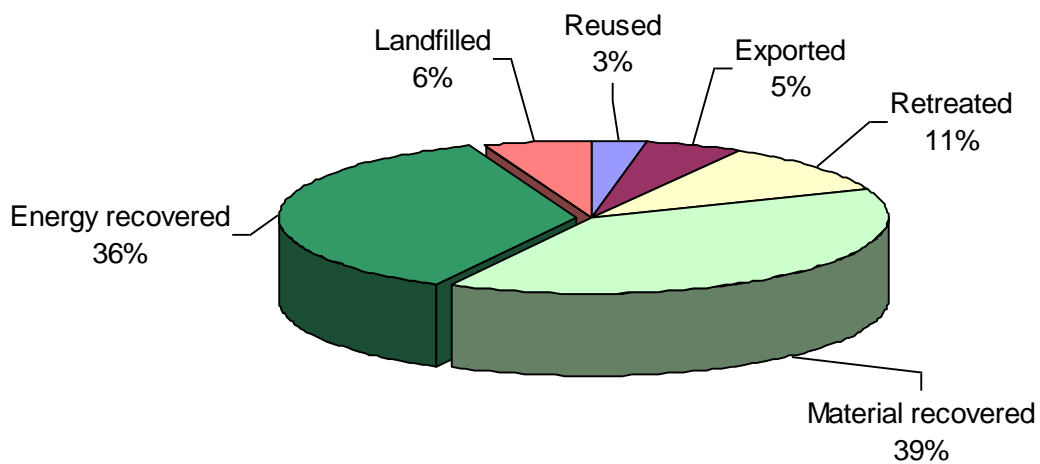


For some specific flows (interesting for the debate about co-processing) the data are not very numerous. The next slides are about sewage sludge and tyres).

Current arisings and estimated arisings of sewage sludge for 2010 and 2020



Tyres treatment 2008 (EU 27 + 2) - Total : 3281000 tonnes

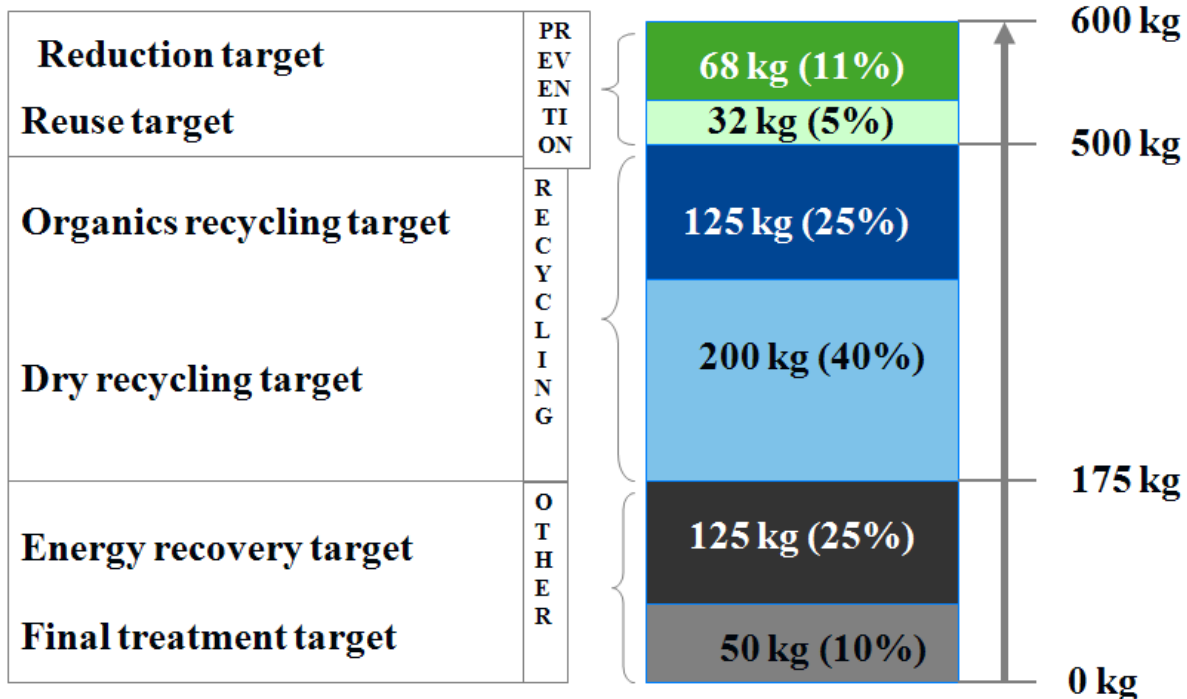


Which are now the drivers of evolution in the field of waste management? Probably, a few targets are important.

The next slide (from the EU Commission) gives a good synthetic view:

		min recovery	min recycling	collection rate
Packaging	2008	60%	55%	
Cars	2015	95%	85%	100%
Electronics	2006	70%	50%	min 4 kg per inhabitant per year
Batteries	2011		50% to 75% (efficiency)	
	2012			25%
	2016			45%
Tyres	2006	0 landfill of tyres		
Biowaste diverted from landfills	2006	reduction to 75% of the 1995 level		
	2009	reduction to 50% of the 1995 level		
	2016	reduction to 35% of the 1995 level		
New targets (WFD)	2015	Separate collection: at least paper/metal/plastic/glass		
	2020	50% household waste and...		
	2020	70% construction and demolition waste		

At the ACR+ level, we think that the following targets could be considered as optimal concerning the different modalities of municipal waste management :



Now the focus goes on LCA and CO₂ balance...and both instruments demonstrate that the five levels of the European waste hierarchy are to follow.

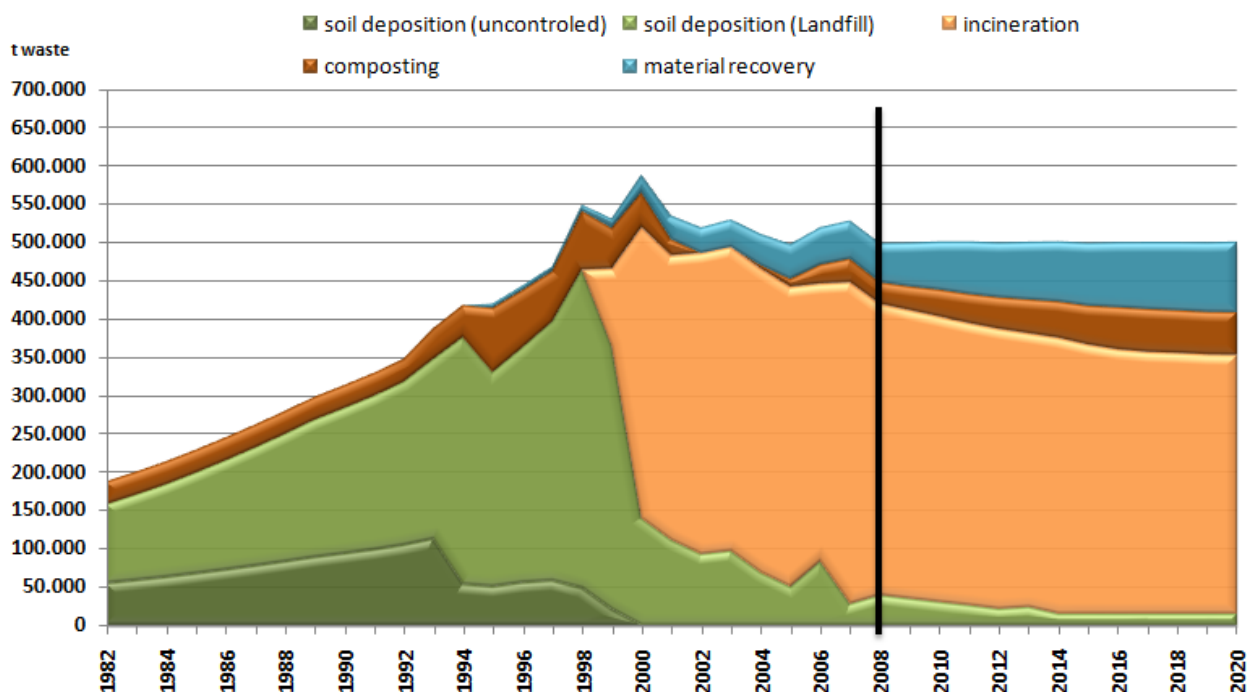
Carbon balance of different waste treatment options

DATA FROM OPORTO (by : Isabel Nogueira and Rui Dinis, Lipor)

Lipor is a Portuguese company that serves 8 municipalities, for a population of about 1 million inhabitants; Lipor's operational units are:

- material recovery (sorting plant)
- organic recovery (composting plant)
- energy recovery (incineration plant)
- final disposal (landfill)

We can present the Lipor's waste management, in the years between 1982 e 2020 as follow (estimated):



From 1999 there's a progressive reduction of emissions due to landfill and an increase of emissions due to incineration, corresponding to a change of Lipor's strategy about waste management.

The Lipor's strategies and goals about GHG emissions reduction are now the following

Total emissions cut <i>per capita cap</i>		
2012	- 12%	356 kg CO ₂ e/hab.ano
2016	- 16%	340 kg CO ₂ e/hab.ano
2020	- 20%	324 kg CO ₂ e/hab.ano

1st priority: less waste >>> less emissions

2nd priority: different management options with different emission magnitude

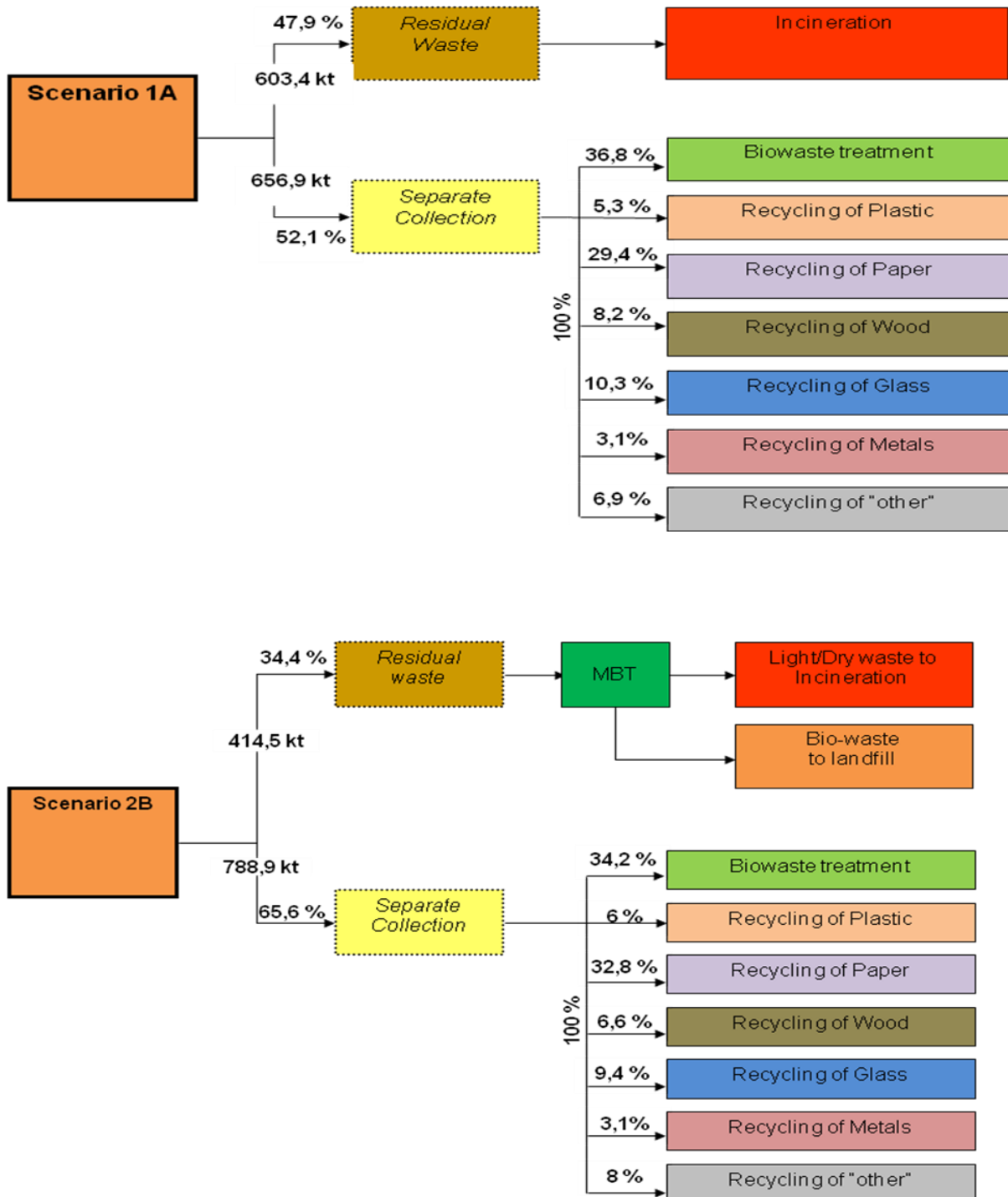


Life Cycle Assessment of Integrated Waste Management Systems: Carbon and energy balance of different scenarios for Torino and Cuneo Districts (by: Gian Andrea Blengini (Politecnico di Torino) and Michele Bertolino (Legambiente))

LCA have been made in Torino e Cuneo Districts. In both cases the specific objective was identifying best energy and environmental performances scenarios through optimisation of the main components of the integrated waste management systems. First of all a panel of stakeholders and experts was set up in order to define the scenarios to be compared (% of separate collection; alternative treatment options; system boundaries), the data collection (Data sources, cut off criteria and responsibilities for data quality) and the selection of environmental and energy indicators (Energy indicators: GER Gross Energy Requirement; NRE Non Renew Energy - Climate Change indicators: GWPt Global Warming Potential (fossil+ biogenic); GWPf Global Warming Potential (fossil)).

For the case of Torino District four scenarios have been considered, in function of separate collection targets and plant choices:

Scenario	% separate collection	Plants for residual waste
1A	52 %	Incinerator
2A	65 %	Incinerator
1B	52 %	MBT + incinerator + landfill
2B	65 %	MBT + incinerator + landfill



The assumptions of the study: waste holds no environmental burdens at the inlet gate; the functional unit is 1 ton input waste; biogenic carbon is accounted for, but reported separately; expanded boundaries and detailed LCA.

In the study there is a detailed analysis of subsystems (collection of residual waste, separate collection, composting, anaerobic digestion, recycling, MBT, incineration and landfill.)

The table below shows some results

		1A (52% sep. collection)	1B (52% sep. collection +MBT)	2A (65% sep. collection)	2B (65% sep. collection +MBT)
ENERGY (GER)	MJ/t	-13.898	-12.858	-17.362	-16.497
ENERGY non-renew	MJ/t	-7.476	-6.499	-8.811	-8.001
ENERGY renew	MJ/t	-6.422	-6.359	-8.551	-8.496
GWP100total	kg CO_{2eq}/t	233	142	26	-46
GWP100fossil	kg CO_{2eq}/t	-156	-160	-230	-241
GWP100bio	kg CO_{2eq}/t	389	302	256	195

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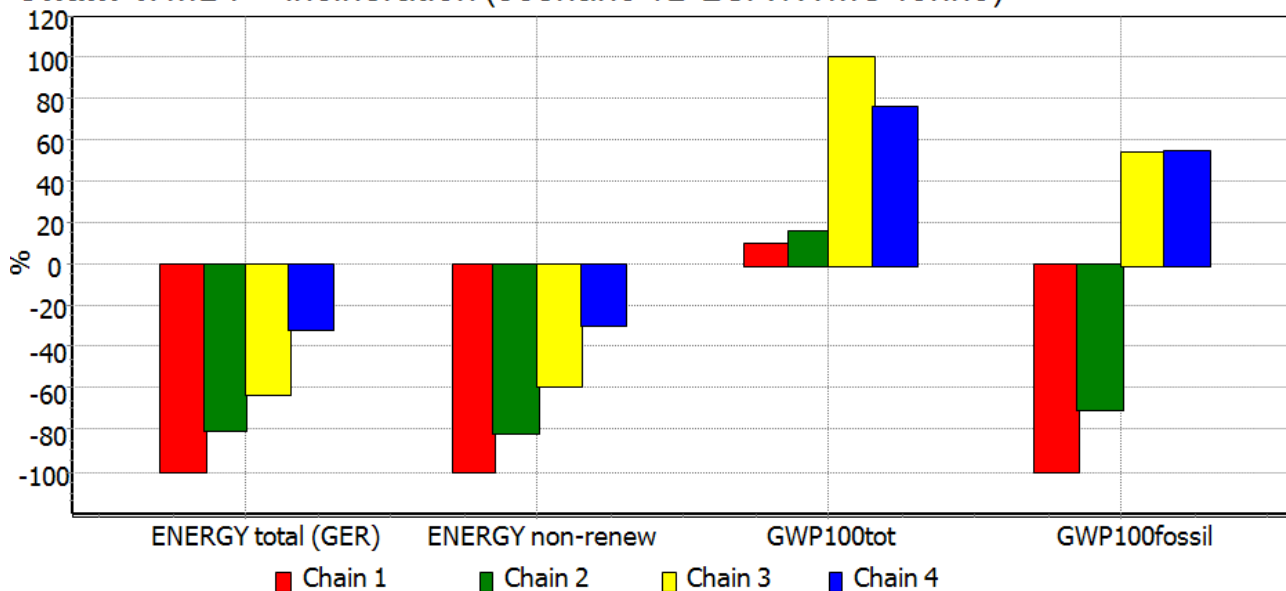
The graphic below shows energy & carbon balance of alternative energy recovery chains from restwaste:

Chain 1: MBT + RDF + co-incineration in cement kiln

Chain 2: Bio-Dry + RDF + co-incineration in cement kiln

Chain 3: Direct incineration (scenario 1A LCA IWMS Torino)

Chain 4: MBT + incineration (scenario 1B LCA IWMS Torino)



The results have been given in 2 months, so time has not been a limiting factor.



THE RECOVERY OF ENERGY RESOURCES IN THE RECYCLING PROCESSES

Food Waste Collections and Anaerobic Digestion in the UK (by Ann Ballinger, Eunomia)

The situation concerning UK household food waste generation is the following:

- 6,7 million tonnes generated (one third of what is bought

- 61% of food waste is avoidable

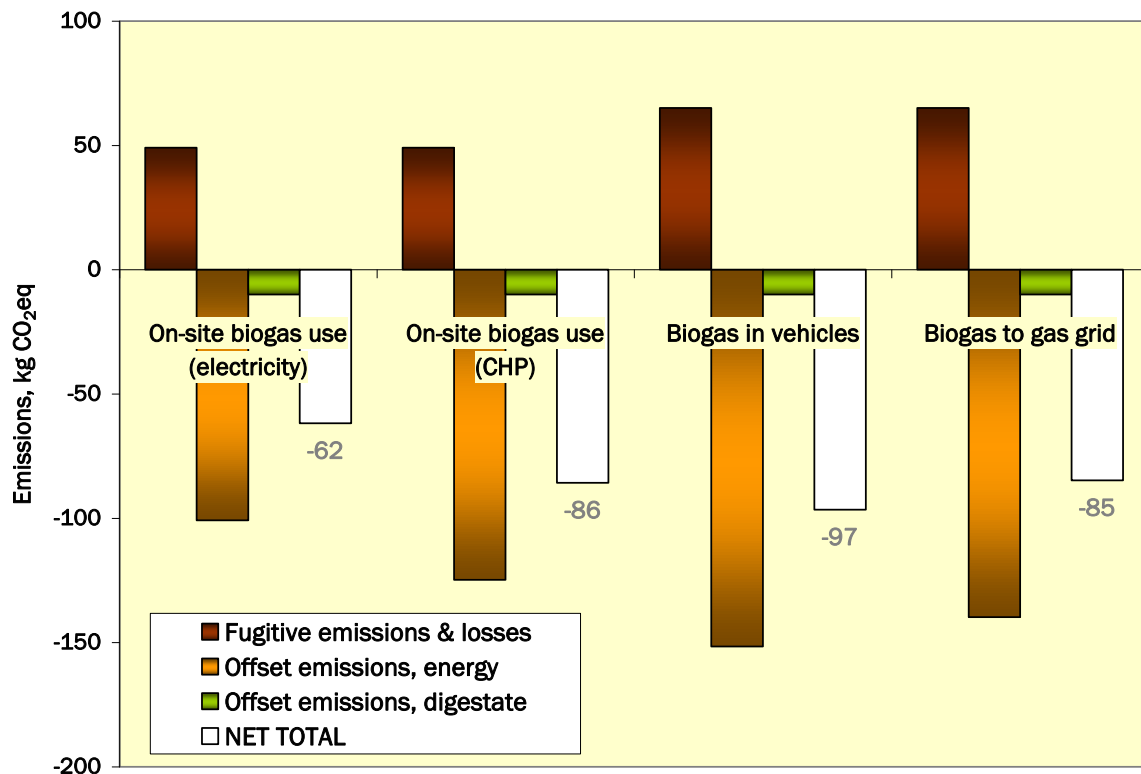
- 1,2 million tonnes still untouched and in packaging

Then the focus goes on UK policy about food waste management. In particular food waste is considered as a source of renewable energy. Besides, UK is considering a ban on landfill of food waste.

In England food waste collection is growing rapidly: today food waste is collected from 3,1 million households (14% of total). Some of the best practices in the UK are based on Italian systems.

It's interesting how food waste collections prevent food waste, because people are sensitised to what they waste. Food waste prevention could allow a reduction of 45 kg/year per household (25% of reduction on 180 kg/years per household, that is the average UK production of food waste). Besides, this level of prevention brings a benefit of 900 kg CO₂ eq. per household.

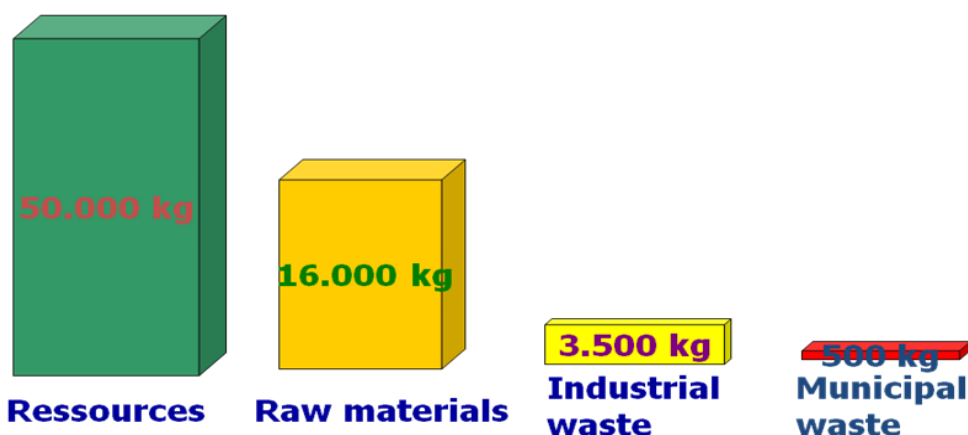
Then the focus goes on the impacts of anaerobic digestion:



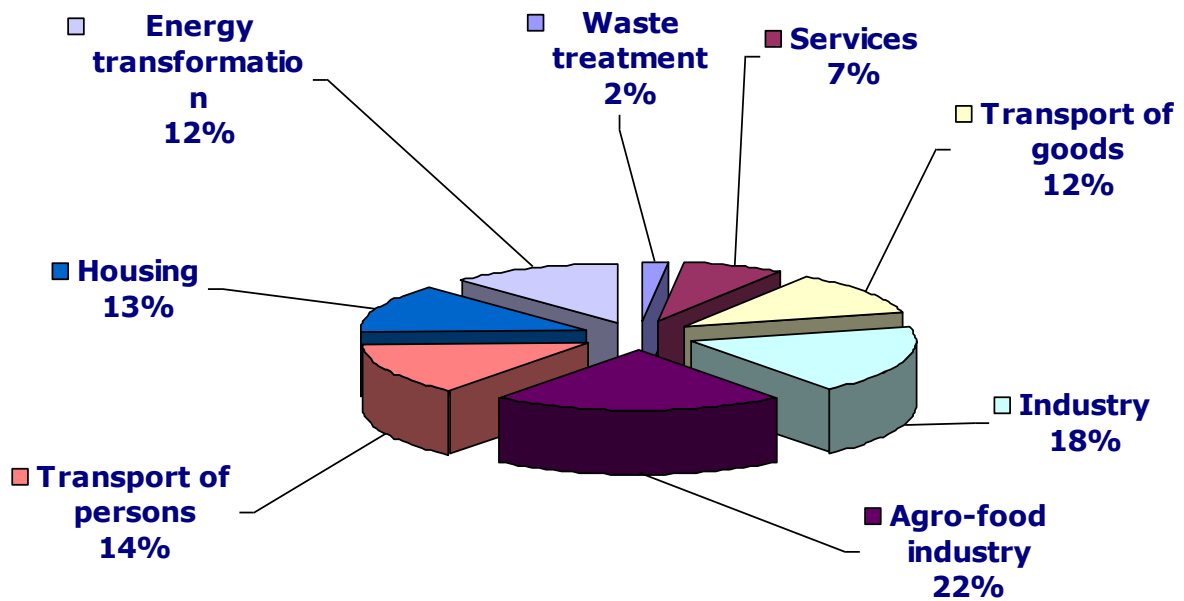
Anaerobic digestion is more functional if there is a separate collection for food waste and home composting is promoted.

The Recovery of Energy in the Recycling Processes (by Francis Radermaker)

In the way from resources to wastes the material production passes from 50.000 kg/inh to 500 kg/inh:

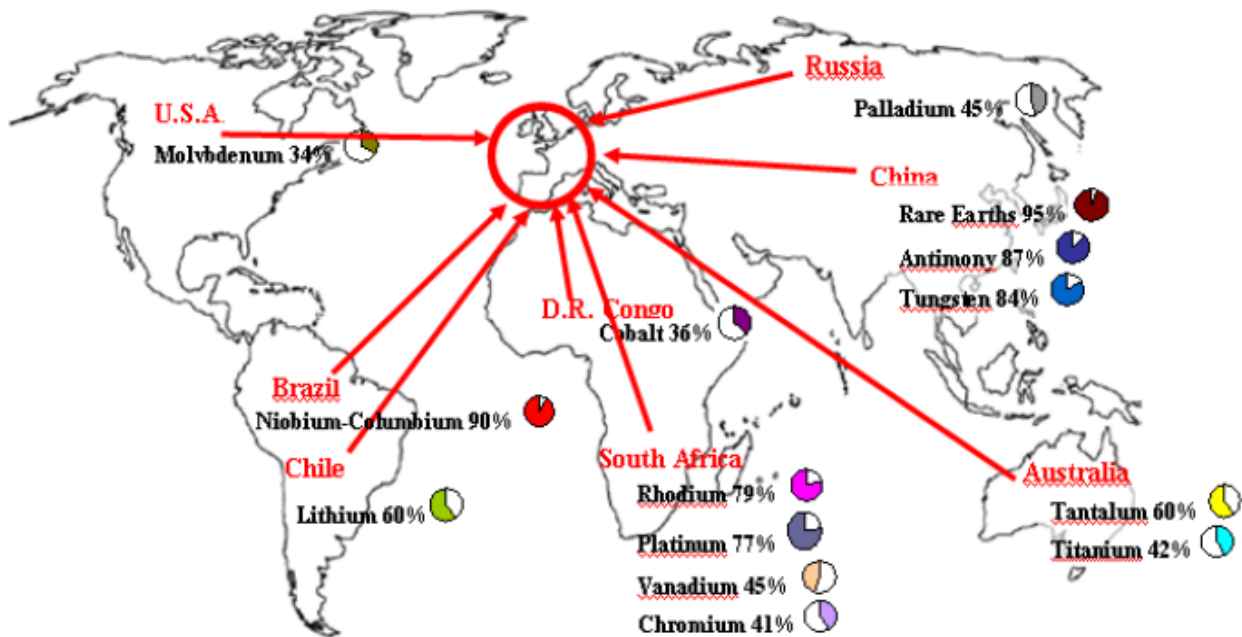


The next graphic is about GHG emissions in France (year 2004):



There are two controversial issues:

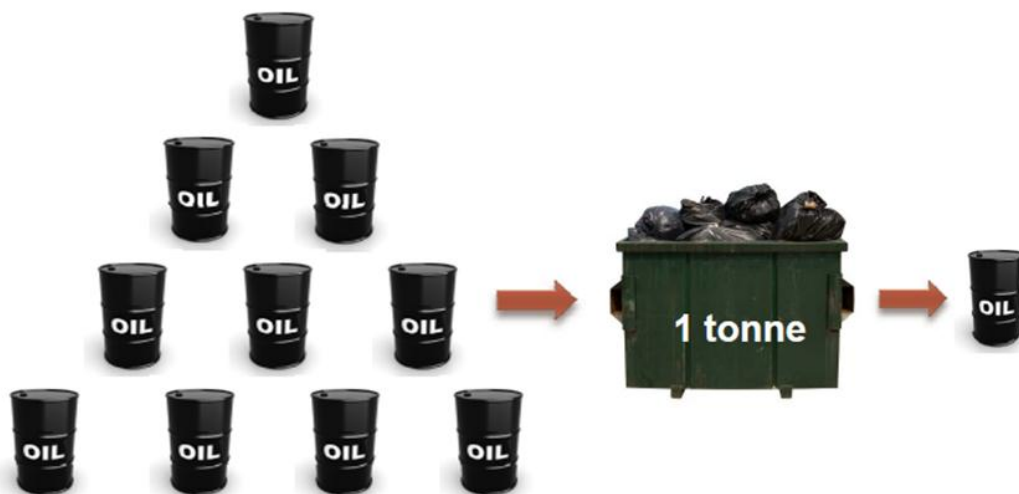
-long distance shipment of waste for recycling (EU is a net importer of raw materials):



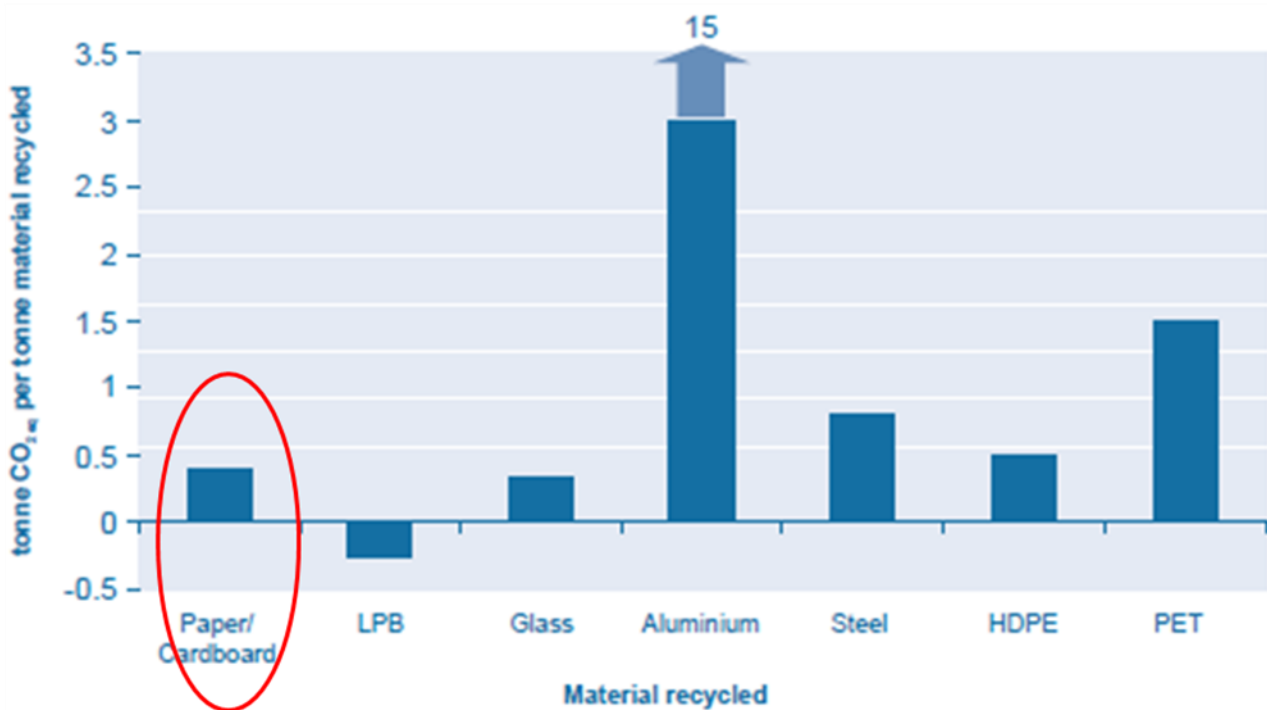
-CO₂ balance of recycling versus energy recovery for combustible waste.

For metal and glass, that represent the 15% of total waste, there is no interest for energy recovery and great interest for recycling.

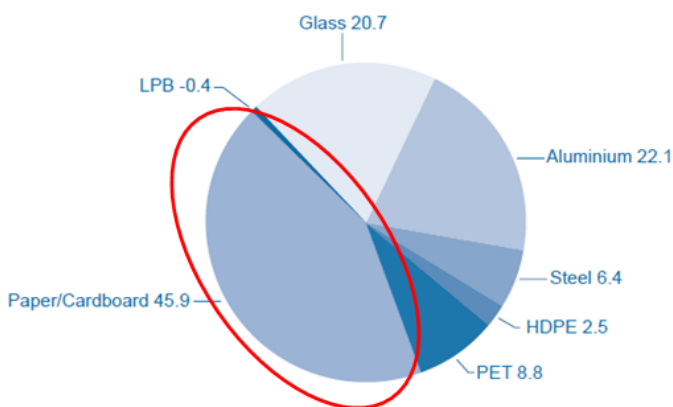
For fossil organics (rubber, plastic, textiles,...), that represent the 15% of total waste, the energy for the production is much higher than the energy that can be recovered:



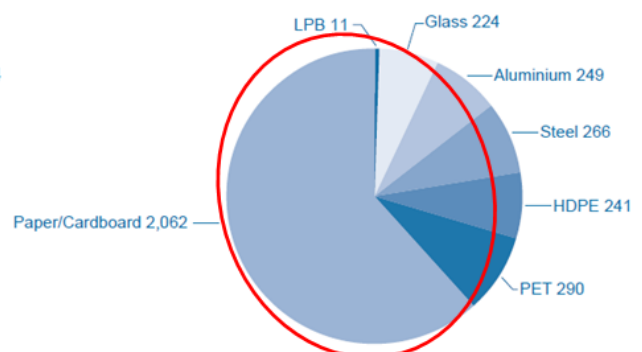
For renewable organics (food, garden, paper,...), that represent the 70% of total waste:



**GHG benefits of Recycling/household
(in kg CO₂)**



**Energy Savings from
Recycling/household
(in MJ per year)**





Conclusions: recycling 2/3 of MSW is achievable and beneficial; the 1/3 that remains may be a good source of energy (MBT); Balance Co-incineration vs. Energy Recovery should be based on relative energy efficiencies.

THE RECOVERY OF MATERIAL RESOURCES IN THE ENERGY RECOVERY PROCESSES

- Waste co-processing in cement kilns: how to conjugate economics, social responsibility and environmental performance (by Raffaele Chiulli, Eurofuels s.p.a.)

What is the European cement industry?

- ❑ Capital intensive 150 M EUR per M ton of production capacity
 - ❑ Global coverage
 - 95% market share in Europe
 - 70% market share in North America
 - Increasing presence in South America and Asia
 - ❑ Local markets Distribution within a typical radius of less than 300 km. In Europe, 94% of cement distribution is land-born.
 - ❑ High energy intensity 1 ton of cement produced requires
 - 60 to 130 kg of oil equivalent
 - ~ 110 kWh of electrical energy
-

In Italy, in particular:



Situation in Italy (ref. year 2007)

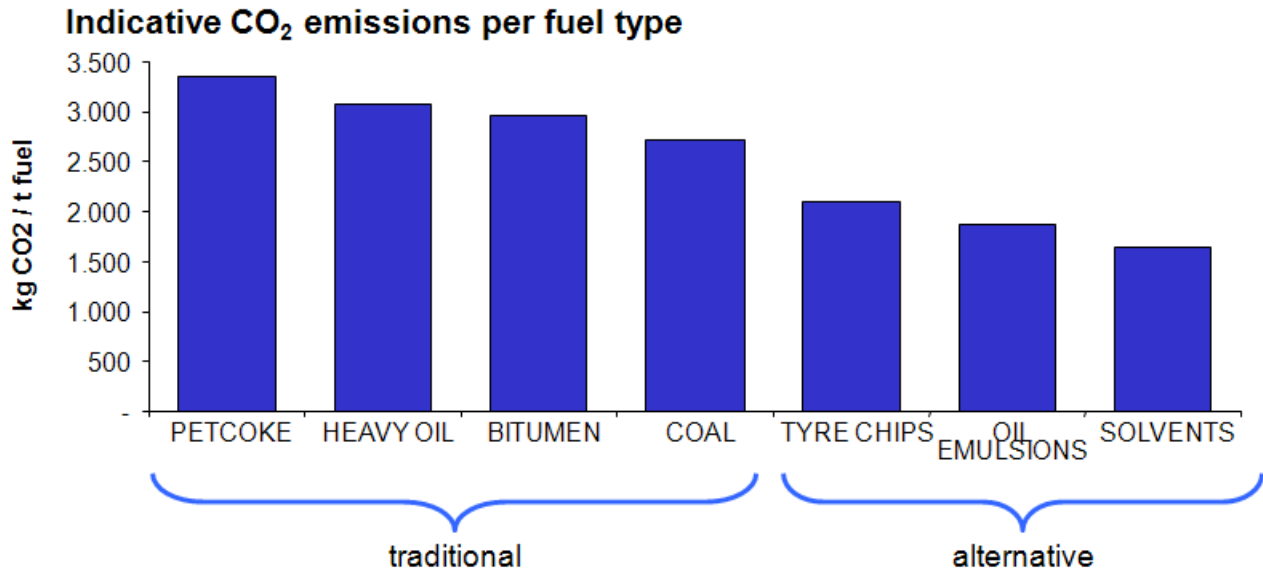
- ☐ Cement plants 88 (59 fully integrated)
- ☐ Annual cement production ~ 47.000.000 t
- ☐ Electrical energy consumption ~ 5.200 GWh
- ☐ Thermal energy consumption ~ 164.000 TJ
- ☐ Fuel mix
 - 88 % coal/petcoke
 - 5 % fuel oil
 - 2 % natural gas
 - 5 % alternative fuels
- ☐ Energy represents more than 60% of variable production cost

Which are the relationship between cement industry and sustainable development?

In 2002, Holcim committed to reduce its global average specific net CO₂ emissions by 20% by 2010, based on 1990 emissions. By the end of 2007, Holcim achieved a 16.3% reduction in net CO₂ emissions per ton cement, indicating that it is on track to achieve its challenging target.

In 2008, the Holcim Group has co-processed 3 M tons of waste, with full thermal and material recovery, thus it saved an equivalent of 2.1 M tons of coal.

What's the balance of waste co-processing in cement kilns ?



The presentation shows that alternative fuels and raw materials conjugate economics, social responsibility and environmental performance.

A confrontation between traditional and alternative fuels, show how only few fuel mixes satisfy all the necessary requirements (technical feasibility, market availability, process optimisation, legal requirements, environmental sustainability and economical convenience).

From waste to energy (by Fabrizio Bonnardel, AMIAT)

The table below shows the served area (data of 2008):

Company	Municipalities	Inhabitants
AMIAT s.p.a. - Turin	1	905.209
SETA – Settimo Torinese	31	251.583
COVAR 14 - Carignano	19	251.946
<u>TOTAL</u>	<u>51</u>	<u>1.408.738</u>

The tables below show landfill's features:

Discarica Basse di Stura "Basse di Stura" landfill			
	Discarica esaurita <i>Old landfill</i>	Discarica nuova <i>New landfill</i>	Totale <i>Total</i>
Superficie occupata <i>Total area</i>	230.000 m ²	660.000 m ²	890.000 m ²
Volumetria complessiva <i>Total capacity</i>	4.000.000 m ³	19.700.000 m ³	23.700.000 m ³
Altezza media dal piano di campagna <i>Height</i>		50 m	
Profondità media <i>Depth</i>		4 m	
Anno inizio attività <i>Opening year</i>	metà anni '70 <i>mid-70's</i>	1983	
Anno di chiusura <i>Closing year</i>	1983	previsto dicembre 2009 <i>forecast December 2009</i>	

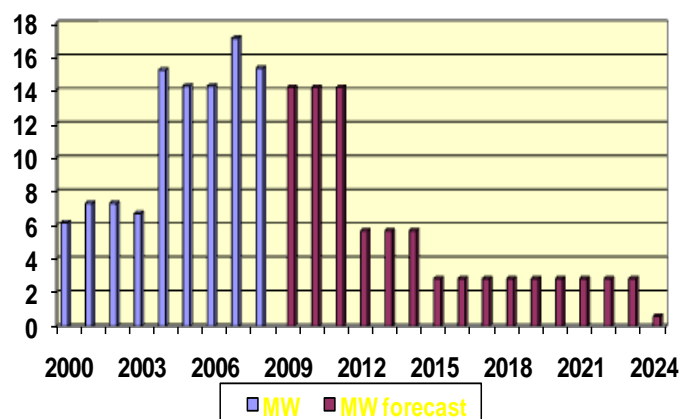
Rifiuti conferiti alla discarica Basse di Stura nel 2008 (tonn) Amount of waste disposed in Basse di Stura landfill (2008) (tons)			
	Torino <i>Turin</i>	Altri <i>Other</i>	Totale <i>Total</i>
Rifiuti urbani (R.U.) <i>Municipal solid waste (M.S.W.)</i>	304.968	72.856	377.824
Rifiuti speciali assimilabili (R.S.A.) <i>Industrial waste</i>	9.504	73.306	82.810
Fanghi da depurazione acque <i>Sewage treatment sludge</i>	79.289	0	79.289
Totale <i>Total</i>	393.761	146.162	539.923

The landfill's gas management system is made by:

- collection wells
- extraction plant (collection pipework, boosters, collection control system)
- utilization and flaring plants

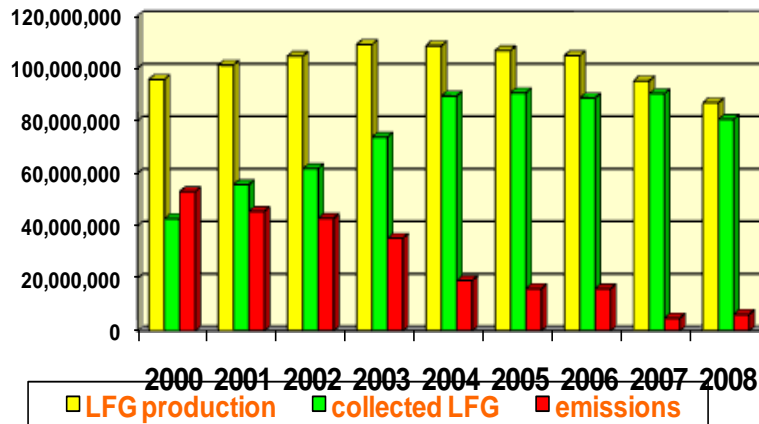
There are 15 extraction plants, for a total suction capacity of 45.000 Nm³/h. There are 5 high temperature flares, for a total flow rate of 9.500 Nm³/h.

The graphic below shows the installed electrical power of LFG power station:

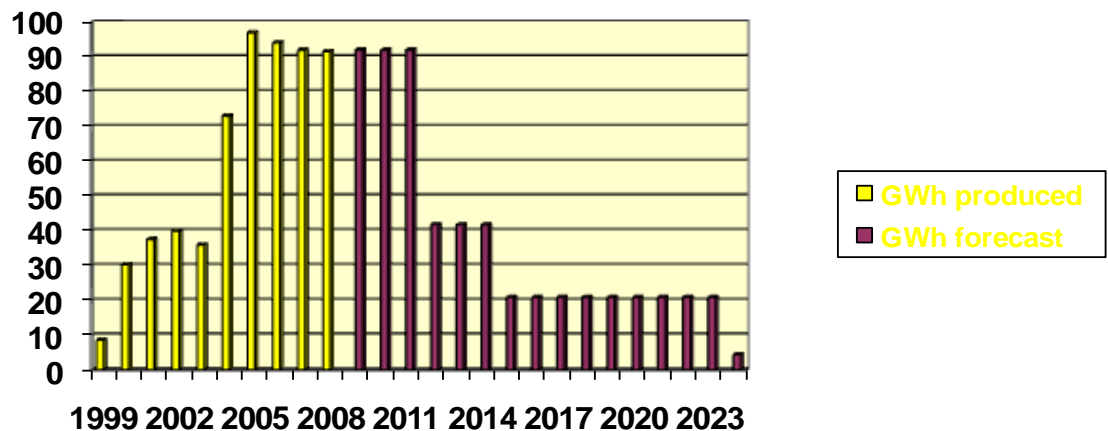


The electrical efficiency of LFG power station is 42%.

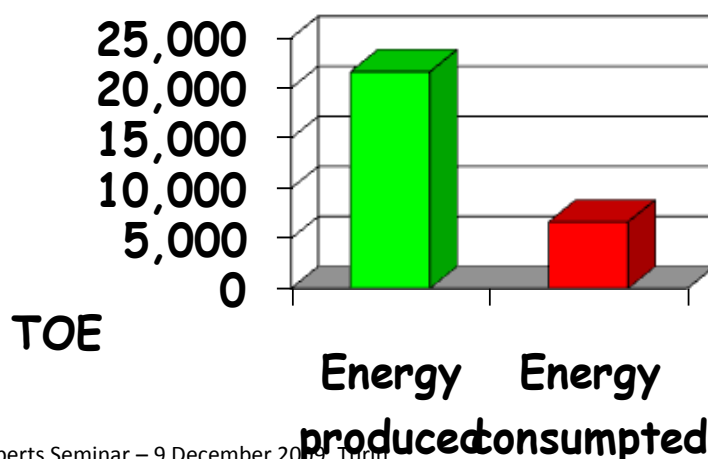
The graphic below shows data about LFG collection:



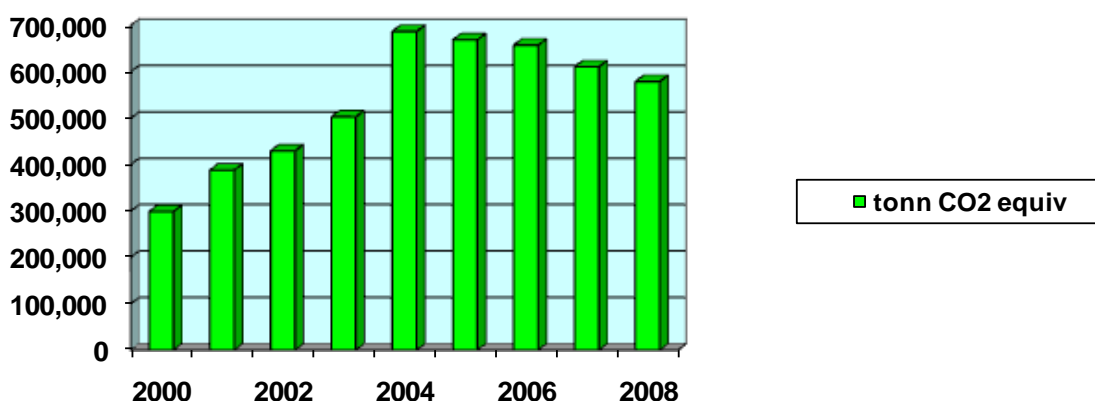
The collected gas is used in order to produce energy. The energy production is shown in the graphics below:



The next graphic shows landfill's energy balance (year 2008):



The next graphic shows the avoided CO₂ emissions:



A complete overview of the energy recovery from municipal waste in Italy (by Roberto Caggiano, Federambiente)

There is a survey, carried out jointly by ENEA and Federambiente, about the identification, on the Italian national territory at 31st December 2008, of 51 plants operating in the thermal treatment of waste and of some special waste categories.

The main results can be summarized:

- By 31st December 2008, on the national territory there were 51 operating plants (consisting of 97 lines) devoted to waste treatment, having an overall nominal capacity of 18,205 t/d, which, during 2007, treated altogether about 4.45 million tons of waste.
- Most of the plants identified by the census (32 out of 51) presents a rather reduced treatment capacity, no more than 300 t/d; 6 of these do not exceed 100 t/d.

As for typologies, the waste treated is mainly made up of waste residues (59.2%), of its fluxes (dry fraction, RDF) derived from both mechanical and biological treatments (21.5%), and of special waste (15.7%), which also includes sanitary waste (hazardous, too) and biomass. The most common combustion equipment are grate combustion furnaces,



representing more than 80%, both in terms of installed lines (79 out of 97) and of treatment nominal capacity. The rest is divided between fluidized bed (9 operational plants with 17 lines, equivalent to 17.6% in terms of treatment nominal capacity) and 4 rotary drum furnaces.

Most plants are waste-to-energy plants (49 out of 51) and energy production must be provided for in all instances. Thermal energy production is carried out within a cogeneration functioning pattern (combined production of electric and thermal energy) on a mainly seasonal basis, and it concerns only 11 plants, all of them in northern Italy.

As for fume treatment, aimed at removing particulates and acid gases, one can notice that the most used system is the "dry" one.

On the issue of nitrogen oxide control, one notices that the selective, non-catalytic reduction (SNCR) inside the steam generator represents by far the most used system (67 lines out of 97).

The removal of organic and inorganic micro-pollutants is done mostly by means of adsorption onto activated carbon, usually injected together with an alkaline reagent.

In terms of emissions in the atmosphere, practically all the plants abide by the limits provided for by the current regulations (Law Decree 133/2005), except for rare exceptions.

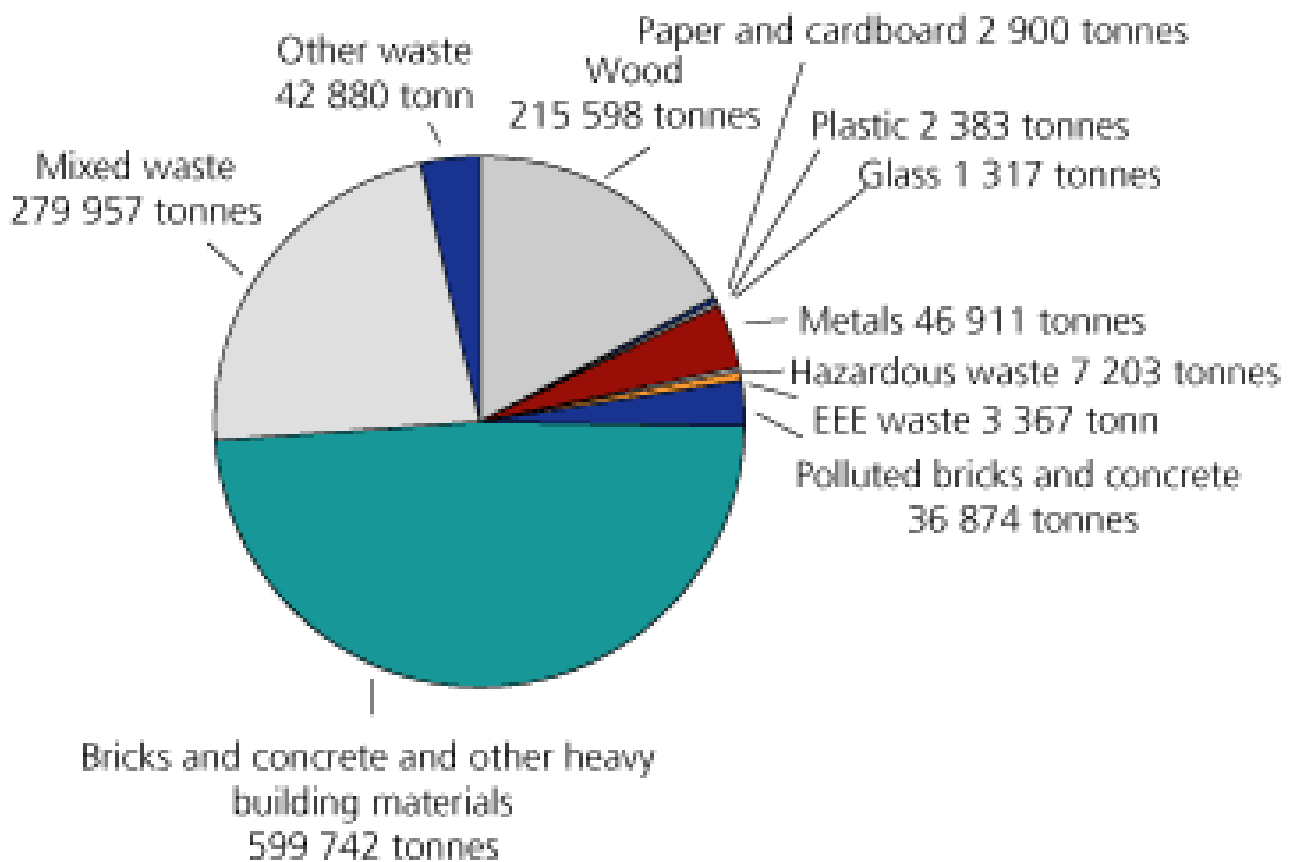
In 2007, thermal treatment produced about 800,000 ton waste and about 200,000 tons of fume treatment residues, the latter were mostly landfilled. As for waste, on the contrary, we can observe a growing tendency to recovery, which has reached a rate of over 50% against the 20% registered in the previous survey.

In the light of the new technological developments which took place and of the environmental and technical performances shown, one cannot, in point of fact, deny that energy recovery can successfully play its role, confirmed by the recent framework directive on waste, within a waste management hierarchy more and more linked to sustainability principles.

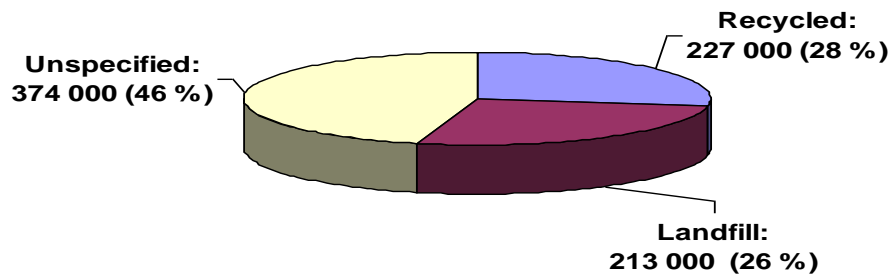
BEST PRACTICES FOR SPECIFIC FLOWS

“Construction and demolition waste from a Norwegian perspective (by Christian J. Engelsen, SINTEF)

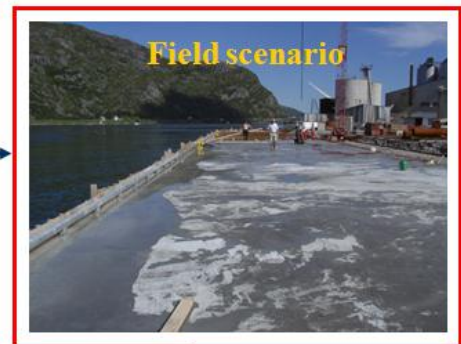
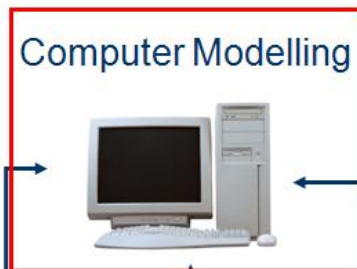
The 2004 Norwegian production of construction and demolition wastes, divided by origin, is as follow:



Next graphic shows the destination of concrete rubble (year 2005):



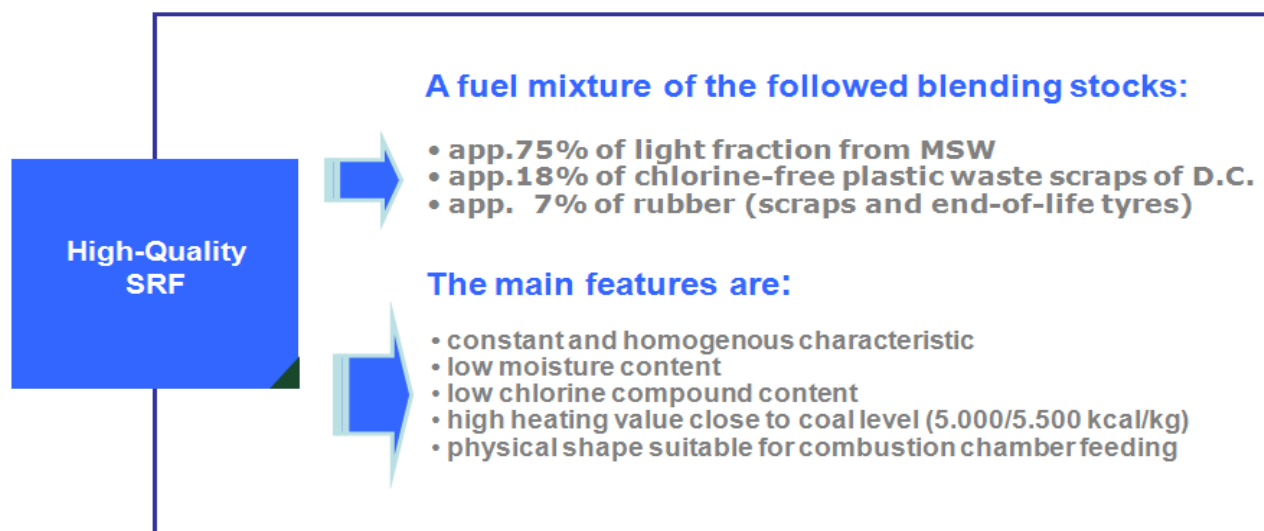
We have some Norwegian examples of buildings built using CD waste (Søremsung High School, Fornebu building site, E6 Highway) with an environmental impact approach:



Residual household waste - Over 7 Years Experience of co-firing HQ-SRF in cement kilns

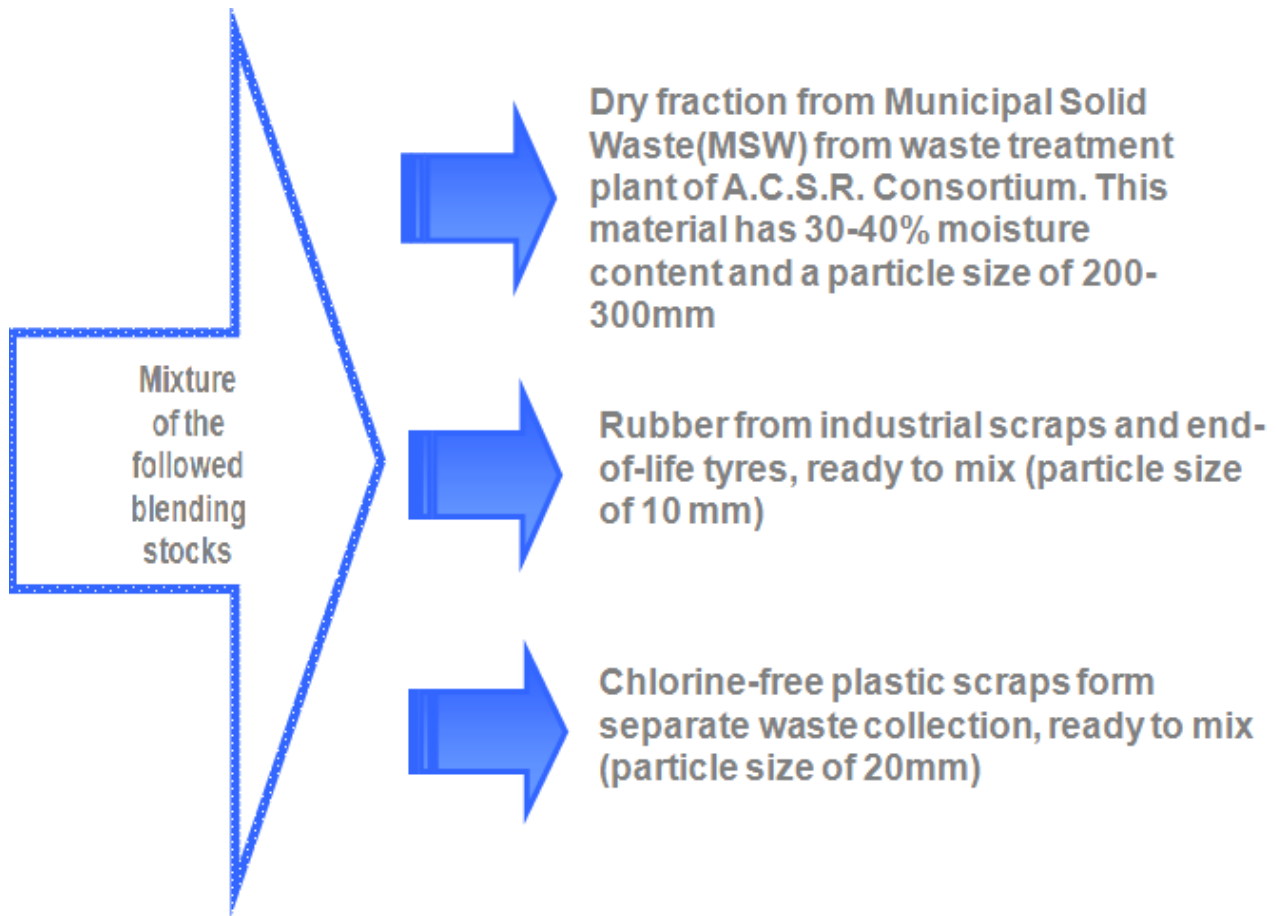
(by Carlo Zanutta, IDEAGRADA)

I.D.E.A. Granda is a company in which A.C.S.R. S.p.A. (a Consortium of 54 Municipalities in the Cuneo district, comprising 154.000 inhabitants) holds 51% and Pirelli & C. Ambiente S.p.a. holds 49%. The speaker explains the production of HQ-SRF and its characteristics:



Then the speaker shows the benefits generated by I.D.E.A. Granda, for municipalities, for Buzzi Unicem cement plant (that uses HQ-SRF) and for environment.

Below there is an explanation of CDR-P production cycle



The tables below show the input and output data:

Input materials	Q.ty [ton] 2003	Q.ty [ton] 2004	Q.ty [ton] 2005	Q.ty [ton] 2006	Q.ty [ton] 2007	Q.ty [ton] 2008	Q.ty [ton] 30/09/2009
MSW - Light Fraction	6.408	14.522	17.551	18.464	19.589	19.031	18.450
Free-chlorine plastics	1.419	2.072	2.518	3.961	4.143	2.452	1.465
Rubber	280	395	1.494	2.267	2.263	2.290	1.160

Output materials	Q.ty [ton] 2003	Q.ty [ton] 2004	Q.ty [ton] 2005	Q.ty [ton] 2006	Q.ty [ton] 2007	Q.ty [ton] 2008	Q.ty [ton] 30/09/2009
CDR-P	6.653	13.346	17.002	19.673	20.913	18.616	16.140
Scraps to landfill	120	162	273	405	480	346	375
Evaporated water from drying system	1.343	3.481	4.288	4.614	4.602	4.809	4.236

The next table shows the main features of CDR-P:

CDR-P		2003	2004	2005	2006	2007	2008	30/09/09	HQ-SRF (UNI 9903-1)
LHV	kJ/kg t.q.	21.899	20.239	21.603	22.771 (a)	22.992 (a)	23.108 (a)	23.207 (a)	>20.000 (a)
Moisture	% p/p t.q.	4,0	2,6	2,1	10,6	10,0	9,9	9,9	<18,0
Chlorine	% p/p t.q.	0,34	0,35	0,37	0,41 (b)	0,34 (b)	0,46 (b)	0,46 (b)	<0,7 (b)
Sulphur	% p/p t.q.	0,11	0,12	0,20	0,11 (c)	0,14 (c)	0,12 (c)	0,10 (c)	<0,3 (c)
Ashes	% p/p s.s.	13,4	14,6	14,1	13,7	13,7	14,1	14,1	<15,0
Volatile Lead	mg/kg s.s.	91,1	64,8	76,9	70,2	62,0	29,5	25,4	<100,0
Chrome	mg/kg s.s.	67,8	46,9	52,6	47,3	42,9	23,5	11,1	<70,0
Coluble copper	mg/kg s.s.	48,2	46,2	45,1	36,0	29,4	27,6	20,1	<50,0
Manganese	mg/kg s.s.	69,2	65,1	59,3	96,8	108,1	113,4	77,2	<200,0
Nichel	mg/kg s.s.	4,9	0,8	5,4	8,0	8,5	8,3	3,5	<30,0
Arsenic	mg/kg s.s.	4,6	4,2	4,6	1,1	0,1	0,3	0,5	<5,0
Cadmium	mg/kg s.s.	1,27	0,12	0,17	0,17	0,11	0,35	0,50	<3,0
Mercury	mg/kg s.s.	0,68	0,33	0,33	0,12	0,21	0,21	0,14	<1,0



CDR-P is delivered to the cement factory by 8 semi-trailers of 80 m³ each, equipped with "walking floor". In cement factory there isn't any CDR-P storehouse, but CDR-P storing is done by semi-trailers (less investment costs). Each semi-trailer can communicate with cement kiln control room and it can feed the CDR-P flow required. By belt-conveyors, weighing systems, pneumatic convey and main burner injection (mixed combustion PET COKE+CDRP). By low NO_x burner designed to burn a mix of pet-coke/carbon-coke/CDR-P, 24 hours/day, 7days/week. Flow rate 500÷5000 Kg/h.

End-of-life tyres - italian experience in the european context (by Gianni Rimondi, Ecopneus)

European legislator requires that producers are responsible for managing their products when they reach their end of life cycle. European tyre industry has defined appropriate models of management for each country, according to local market and legislation. In Italy a specific organization, Ecopneus, has been created by the 6 main tyre producers/importers. The Italian situation is as follows:

Tyres dismantled	380.000
Reused/remoulded tyres	90.000
	290.000
tyres ELV	30.000
ELT	320.000
Material recovery	80.000
Energy recovery in Italy	100.000
Energy recovery out of Italy	70.000
Not identified	70.000
	320.000



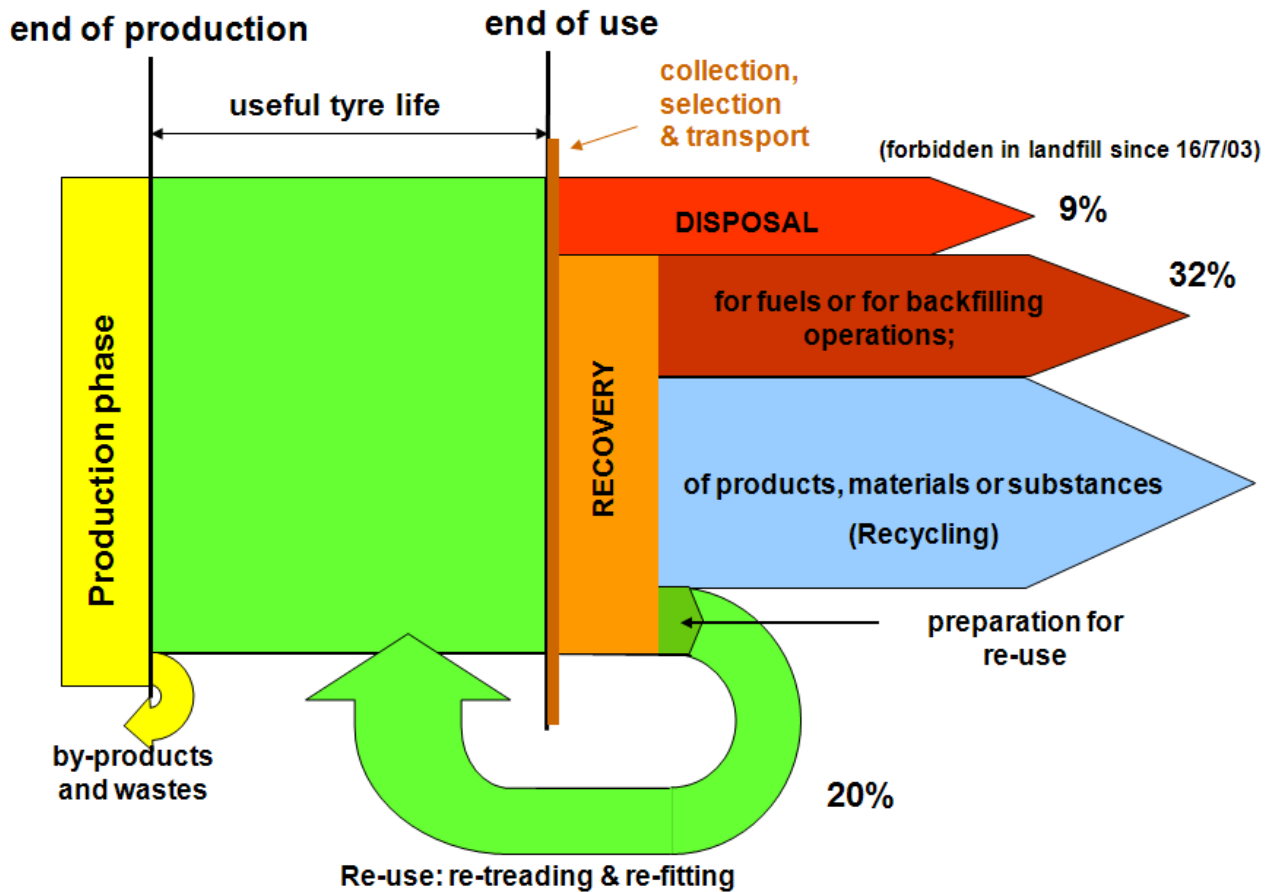
In Italy 25% of ELT (end life tyres) are illegally treated each year; only 20% of ELT are recovered as material each year. The main Ecopneus' objectives are:

- Elimination of illegality
- Increase of material recovery
- Achieve balance between demand and offer

The main actions expected are:

- Collection at the point of waste production, destination control and tracking
- Control of energy recovery and application development
- Partners selection, vendor rating and effective controls

The graphic below shows the stream of
ELT:



The composite's nature of tyres structure and the chemical links that develop during the curing reaction, make extremely difficult to recycle tyre derived materials into the original production process. Concerning the energy recovery, tyre calorific power is equal to coal's one.

In the table below ELT's market sector applications are shown:

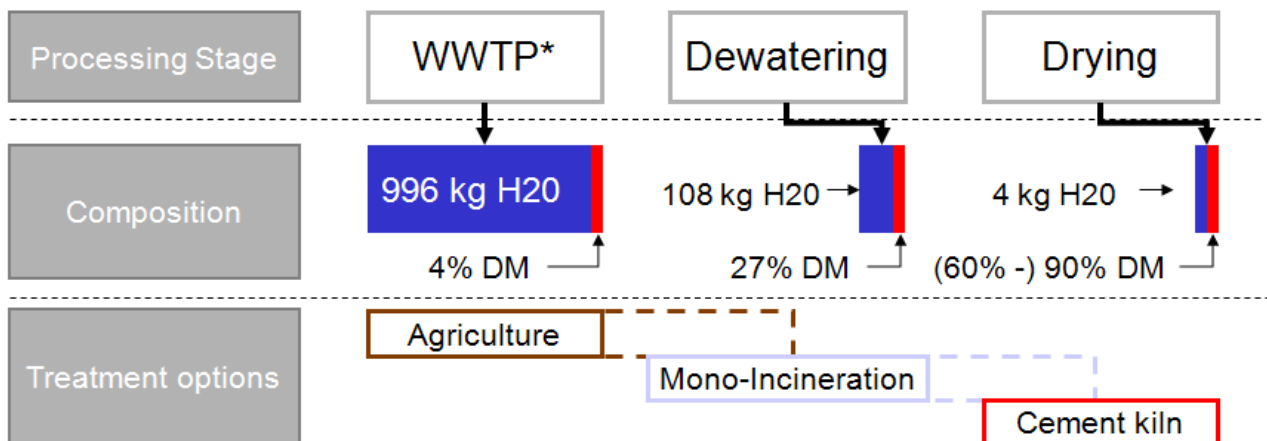
Market sector Applications	
Landfill engineering	Shredded used tyres can be used as a stabilisation and/or drainage layer in landfill construction. The substitutes include stone. Shred is cheaper and has the same performance.
Civil engineering (non-road)	Construction products – can include uses such as drainage filler and alternative to traditional aggregates in block applications and railway crossing matting. Recycled tyres perform as well as aggregate but are cheaper.
Civil engineering (road)	Road repair and maintenance – can include use of granulated rubber in modified asphalt and shred as roadway base layers. The alternative is to use aggregate stone. The performance is equivalent but recycled tyres are considerably cheaper.
Sports, recreation and safety surfaces	<p>Loose surfaces – including equestrian ménages, bridleways, play surfaces such as artificial turf pitches, and pathways including cycle and footpaths. Bound rubber sports surfaces and safety surfacing for playgrounds.</p> <p>Equestrian (steel removed) – the price and performance of tyre shred are comparable to its substitutes of wood fibre, silica sand and grass.</p> <p>Sports surfaces and playground surfaces – competes with plastics, both of which are more expensive but are available in more colours. Some surface providers use virgin rubber or alternatives on the top layer (having used tyre-derived crumb as the base layer) to benefit from the greater choice of colours.</p>
Consumer and industry	Moulded rubber products – includes carpet underlay, rubber blocks, composite slates, internal construction board and items of street furniture.

The next graphic shows European trend about ELT:

		1994	1996	1998	2000	2002	2004	2006	2007
USED TYRES	Reuse-export	11%	8%	11%	10%	11%	9%	9%	9%
	Retreading	10%	12%	11%	11%	11%	12%	12%	11%
	Material Recovery	6%	11%	18%	19%	25%	28%	34%	39%
	Energy Recovery	11%	20%	20%	21%	27%	31%	32%	32%
	Landfill	62%	49%	40%	39%	26%	20%	13%	9%

Sewage Sludge (by Luiz Carlos De Souza, Holcim)

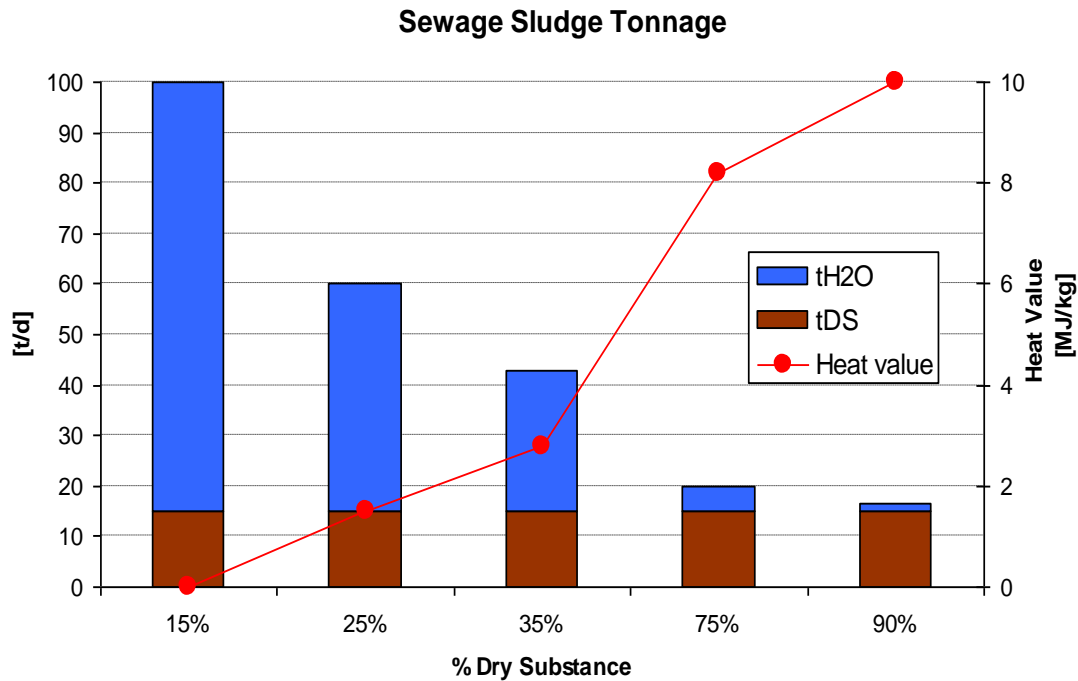
The problem of sewage sludge can be represented as follow:



- Contaminants in Sludge include
 - Pathogens
 - Heavy metals (e.g. Cu, Ni, Zn...)
 - Organic compounds (AOX, PCB, PCDD/F, trace amounts of e.g. pharmaceuticals, hormones)

*WWTP: Waste Water Treatment Plant

Reducing the water content is key for environmentally sound and cost-effective sludge treatment (less water means lower energy for and cost of transport)



Several technical options exist to reduce the sludge water contents and improve the environmental impact of the treatment chain:

Mechanical dewatering

Drying at WWTP

Solar drying

Drying at cement plant

Which are the pros and cons of swage sludge co-processing?



Pros

- Recovery of both, energy and materials
- Local solution
 - near to source
 - no additional (large) investments
- No residue left, but product obtained

Cons

- Drying needs

There are existing a few Holcim co-processing installations in Europe and China.

The conclusion is that cement kiln co-processing is a viable and cost-effective solution for sludge.

Sewage Sludges – The Holcim (Italia) experience (by Marco Turri, Eurofuels s.p.a.)

Water treatment plants generate, during the water cleaning process, sewage sludges. Dried Sewage Sludges (DSS) are these sludges, properly dried through thermal treatment.

DSS main characteristics are:

water content max 15%;

ashes max 55%;

calorific value min. 7000 kJ/kg;

The project opportunities for the Authorities:

- Finding of an industrial process that allows a long term energy valorization
- Utilization of existing industrial sites
- Absence of by products/ wastes from coprocessing
- Opportunity to dispose in a safe way, a waste whose quantity is increasing, without affecting current municipal waste treatment plants



- ▶ The waste energy recovery is preferred to traditional disposal according to Directive 2006/12

The project opportunities for Holcim:

- ▶ Long term availability of an alternative fuel, which influences neither the cement production process nor the quality of the end product
- ▶ CO₂ emission reduction by using a CO₂ free biomass alternative fuel
- ▶ Service to the local Authorities in the waste management

A specific case: the Merone's plant, in Italy.

Merone Cement Plant was authorized by Regione Lombardia in April 2005 to co-process DSS. The authorized quantity is 13 kt/year. Since February 2006, after the required plant modifications, the cement plant is coprocessing DSS coming from Milano, Monza and Merone. The IPPC permit was integrated with this activity in October 2007.



Incinerator Bottom Ash (IBA): Disposal Problem or Recovery Opportunity (by Tom Mc Carthy, Resource recovery)

Established that we have to manage big quantities of municipal solid waste and that we need to reduce the generation of this waste and maximise what we reuse and recycle, it's necessary to decide how to manage the residual waste. Residual waste contains resources that can be recovered: energy and materials. The solution that is now adopted increasingly in Europe is to incinerate the residual waste with recovery of energy in the form of electricity and heat. In the past, incinerators were often the source of atmospheric pollution, but modern incinerators have solved this problem. The problem now is related to bottom ash and fly ash. Bottom ash represents 20-25% of the incinerated waste. About 90% of bottom ash is a mineral fraction that resembles a mixture of sand and gravel. Bottom ash contains valuable resources: metals and other minerals. There are well-known technologies for recovering the ferrous and non-ferrous metals and a ready recycling market for these metals. The recovery of any useful materials from fly ash is more difficult because of the hazardous nature of some of the residues captured by the pollution abatement equipment. There are no proven solutions for fly ash recovery at this time, but development work is continuing.



DEBATE / A FEW QUESTIONS

To Jean Pierre Degré

1) Waste in cement plants: when waste, when fuel?

Under the value of 2.000 kcal/kg, there's a passage of energy from the flame to the waste, over that value the waste gives energy to the flame. If the plant accepts wastes under 2.000 kcal/kg for co-processing, then this activity has to be considered a disposal (a waste service activity).

2) Which treatment with pesticides in cement plants?

It's still controversial. The first trial was done in Vietnam in 2003, using a soil contaminated with 2.000 ppm of PCB. The material had a PCI much higher than a traditional fuel, but Greenpeace noticed an increased production of NO_x.

3) Would not be interesting to calculate how the different activities of waste management (like waste reduction or waste recycling) impact on energy saving and GHG emissions ?

It's a concept that is not yet developed, but it would be interesting to examine it.

4) Data report from the different States has a political side. The States that have high levels of recycling seem to report higher levels of total production, the other way around for the ones that have low levels of recycling. Does exist a correlation?

There is direct correlation between GDP and waste production. The most developed countries have an higher production. There are still no rules to report waste production, every country decides for itself.

5) Are the European target about biowaste diverted from landfill enough clear?

There are three targets, considered too low from some of the state's members.



To Gian Andrea Blengini

1) In the participate process, did you include also the boundaries of the LCA?

Yes, we did.

2) What do you mean by “waste holds no environmental burdens at the inlet gate”?

We consider the material's environmental impact only when it becomes waste.

3) Is the LCA considered by Italian authorities for delivery permits?

Up to today it's not considered by the authorities for delivery permits. This is a Legambiente's target for Piedmont Regional plan.

4) It would be interesting to examine the tyres flow waste. Do you have any data about it?

We have some data about Asti province: the stream of this material is important but not so relevant in terms of weight percentage. By the way, in the full study we have all this data also for Turin and Cuneo provinces.

5) It would be interesting to analyze the economic part of the LCA.

In the last chapter of our study we did it.

To Rui Dinis

1) It's true that incineration has a lower GHG impact than landfill disposal, but considering the big picture there are other environmental impacts that can make us change the opinion. It would be appropriate to consider waste reduction and waste recycling as a good alternative.

I completely agree. In fact, talking about the emission reduction from the energy mix, we consider the marginal emission factor and not the average one.



To Francis Radermaker

Holcim is ready to co-process the not recyclable paper sludge, that is after it has been recycled 6 times. Moreover in Holcim's point of view, co-processing to produce something (cement, glass, heat, steam) is better than incinerating wastes for no other purpose than to eliminate it.

It's true that we could close 50% of European incinerators. It's also true that it's important to improve energy efficiency for both co-processing and incineration.

To Ann Ballinger

1) Is it possible to have a clarification about the comparison of co-processing and MBT related to CO₂ emissions?

Referring to the AD graphic, the organic fraction comes separate collection and not from an MBT process. In the MBT process usually the purpose is to separate the materials with higher values of low calorific power (paper, plastic, etc...), while what is left (usually the organic fraction) has a different destiny, like landfill after stabilization.

2) What about the presence of heavy metal in food waste and then in compost?

The presence of heavy metals is most likely to happen in the MBT process. In composting process it's less probable, because the material comes from separate collection, so it has a better quality.

3) You showed that in Somerset there was a reduction of total waste production. Is that related only to the introduction of food waste collection?

No, they introduced a new collection system also for other materials.



To Roberto Caggiano

What is the level of energy efficiency of Italian existing plants?

In Italy we have three different categories of efficiency: low efficiency, medium efficiency and a few recent plants that have high efficiency, because they are built with the latest technologies. We can't be happy about the global situation.

To Giovanni Rimondi

What's the meaning of 20% reuse of the tyres?

1) IT is combination of tyres that are dismissed when they are legally still usable and sent to the market of eastern Europe, plus the tyres that are re-fitted and that can be sold.

2) Do you have an idea about the percentage of tyres re-traded, between cars and trucks?

About 80-90% of tyres re-traded are truck's tyres.

3) Did you made a LCA analysis about CO₂ benefits for the different possible treatment for tyres?

No, we didn't make this kind of analysis.

To Christian J. Engelsen

1) In Norway do you expect to recycle C&D wastes into concrete? In what percentage?

Today in Norway there is a limited use of recycled concrete aggregate for new concrete. This is due to low stability of the volumes that can be delivered, when a specific amount of material is needed for every project.

2) In which way do you intend to manage the materials: with mobile plants or with stationary plants?

We have tried with a stationary plant, but the main struggle was the illegal dumping, that caused not to receive enough C&D waste. So we moved to mobile crushing plants.



To Tom Mc Carthy

1) If we can use MSW in cementer plants and if also ashes can be used, do we need incineration plants?

We can use the co-processing in cementer plants to drastically reduce the amount of waste that goes to landfill. It's not my intention to justify or not incineration plants. At the moment I don't see any ways to replace incineration.

2) There are differences about ashes between countries with high selective collection from countries with low rate of selective collection ?

Yes, the quality of the ashes is related to separate collection, so we have differences from country to country and from city to city.



Conclusions

By Roland Jan Meijer

It's very important that we started thinking at waste as an opportunity. Waste can be a much more useful resource than just a material to be disposed in landfill. As a lawyer involved in governmental affair my opinion is that waste is not yet considered as an energetic resource, because the difference of prize from the raw material is not much. Waste is seen as an environmental problem and not as an energetic opportunity, also for the energetic independence that Europe is now looking for. European legislation is old, it is often based on precautionary principles.

By Jean Pierre Hannequart

We know that there are limits concerning material resources, so the topic is to optimize use, reuse and recycling of resources. Co-processing can be a solution but not for every kind of waste. It's important to understand which materials can be co-processed, what technologies have to be used and what kind of efficiencies we can reach, in order to have a sustainable activity. We have to consider EU waste hierarchy, so before discussing about waste treatment, we have to improve waste prevention and product reuse. This is validate by CO₂ criteria. CO₂ is not the only criteria of choice: LCA is another tool that can be used. We absolutely need a participation process beside the LCA study.

Concerning the follow up of this meeting, we should think about a peer review of studies concerning the CO₂ waste balance of waste management with the involment of all the stakeholders at an European level. Next year we will have a Spanish presidency and we will discuss on sewage sludge directive renewing. It remains another issue to discuss: green certificates not only for energy recovery but also for waste recycling.