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AN UPDATE ON WASTE MANAGEMENT AND WTE FACILITIES IN ITALY

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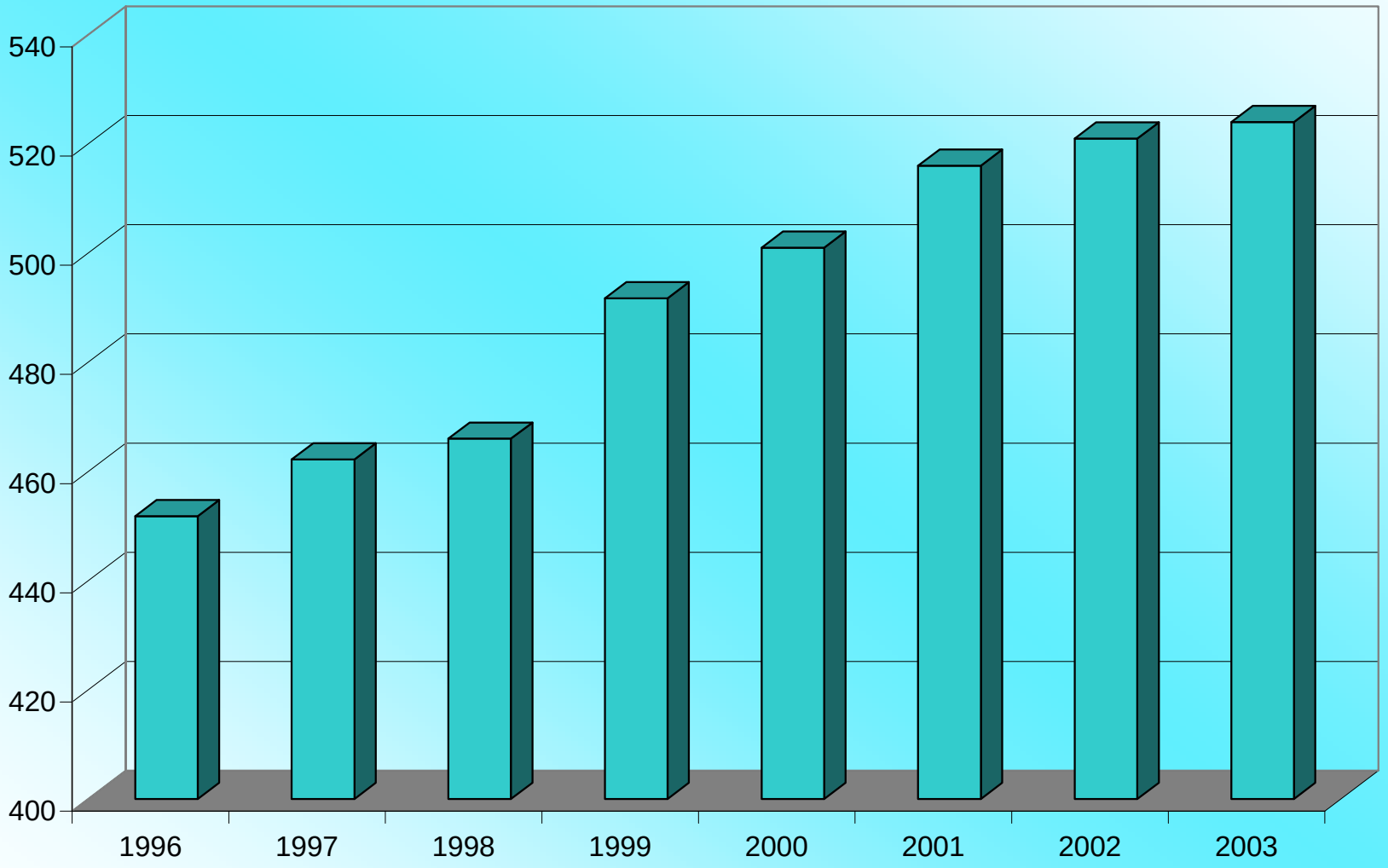
SUMMARY

1. Waste management in Italy – overall outlook
2. Energy recovery from waste
3. Research activity at Politecnico di Milano

MUNICIPAL WASTE PRODUCTION

Historical trend of average per capita production (kg/person/y)



SOURCE: Waste Report 2004, NWO

5th EU Environmental Action Program target ➔ 300 kg/person/y

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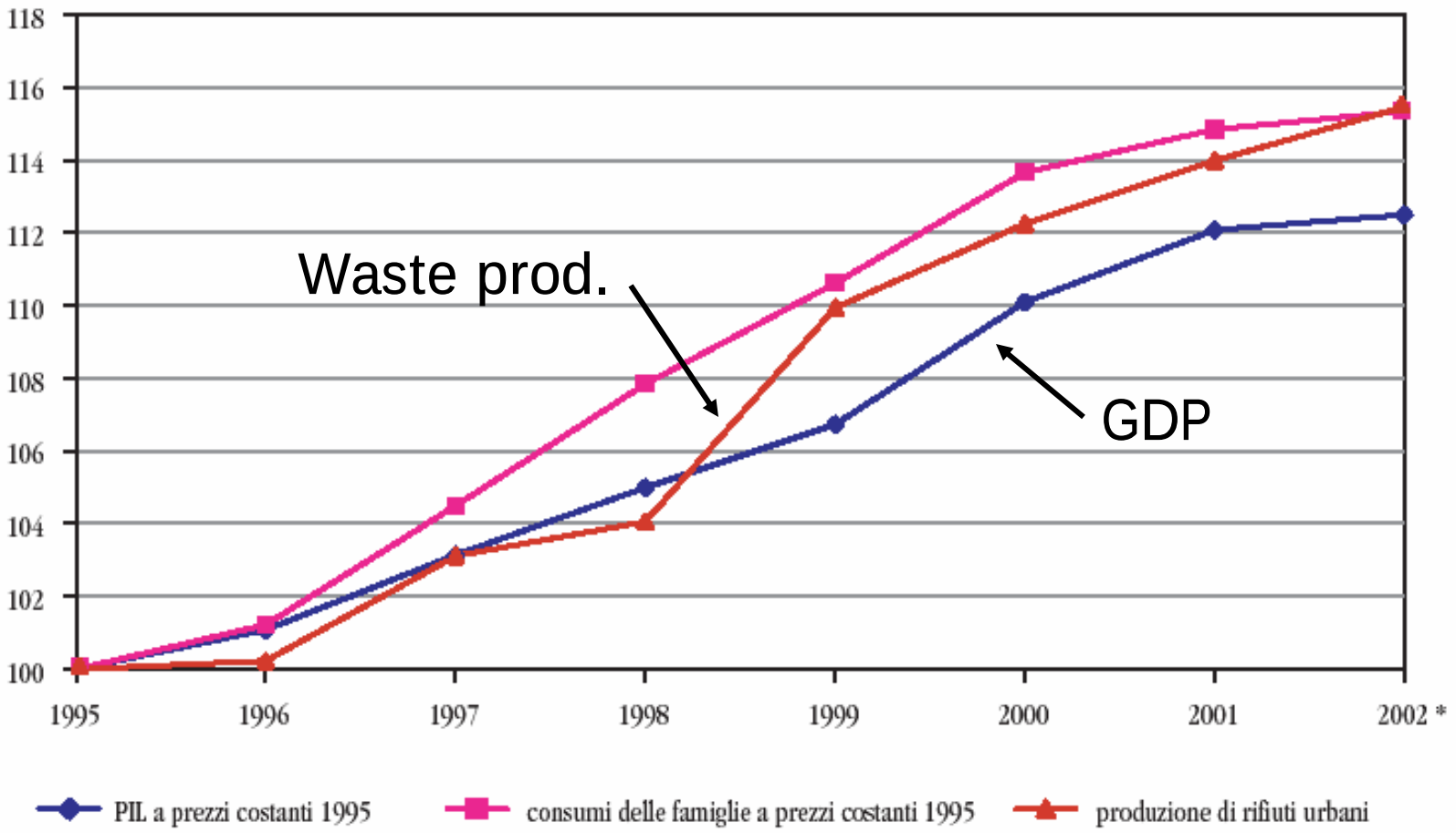
MUNICIPAL WASTE PRODUCTION

Waste production vs. GDP



SOURCE: Waste Report 2003, APAT

MUNICIPAL WASTE PRODUCTION

Per capita production, Regional breakdown, 2002

SOURCE: Waste Report 2003, APAT

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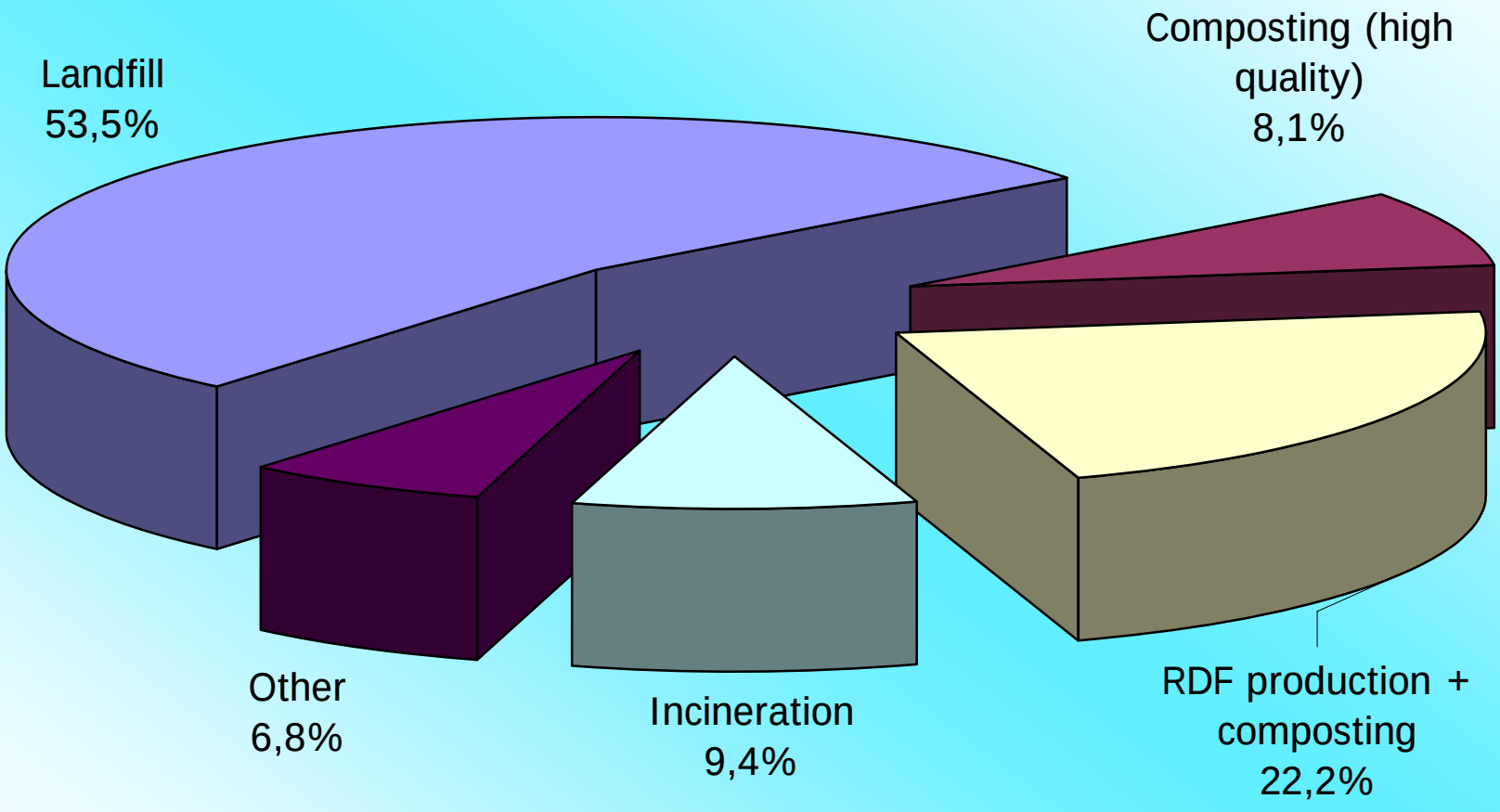
WASTE MANAGEMENT

Situation in 2003



SOURCE: Waste Report 2004, NWO

Similar to the U.S.!!

(Source: "The state of garbage in America", Kaufman et al., 2004)

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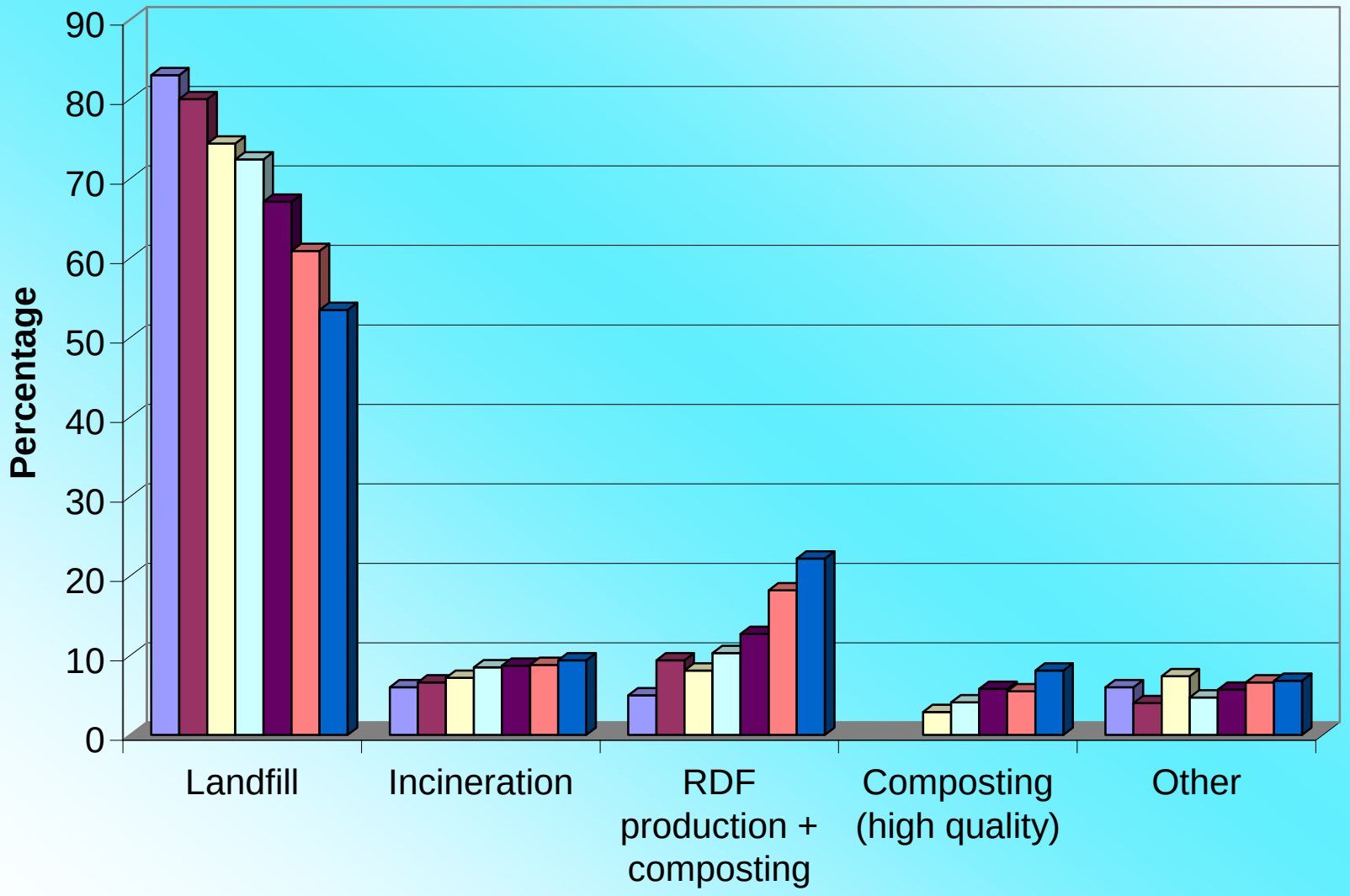
WASTE MANAGEMENT

Trend 1996-2003



SOURCE: Waste Report 2004, NWO

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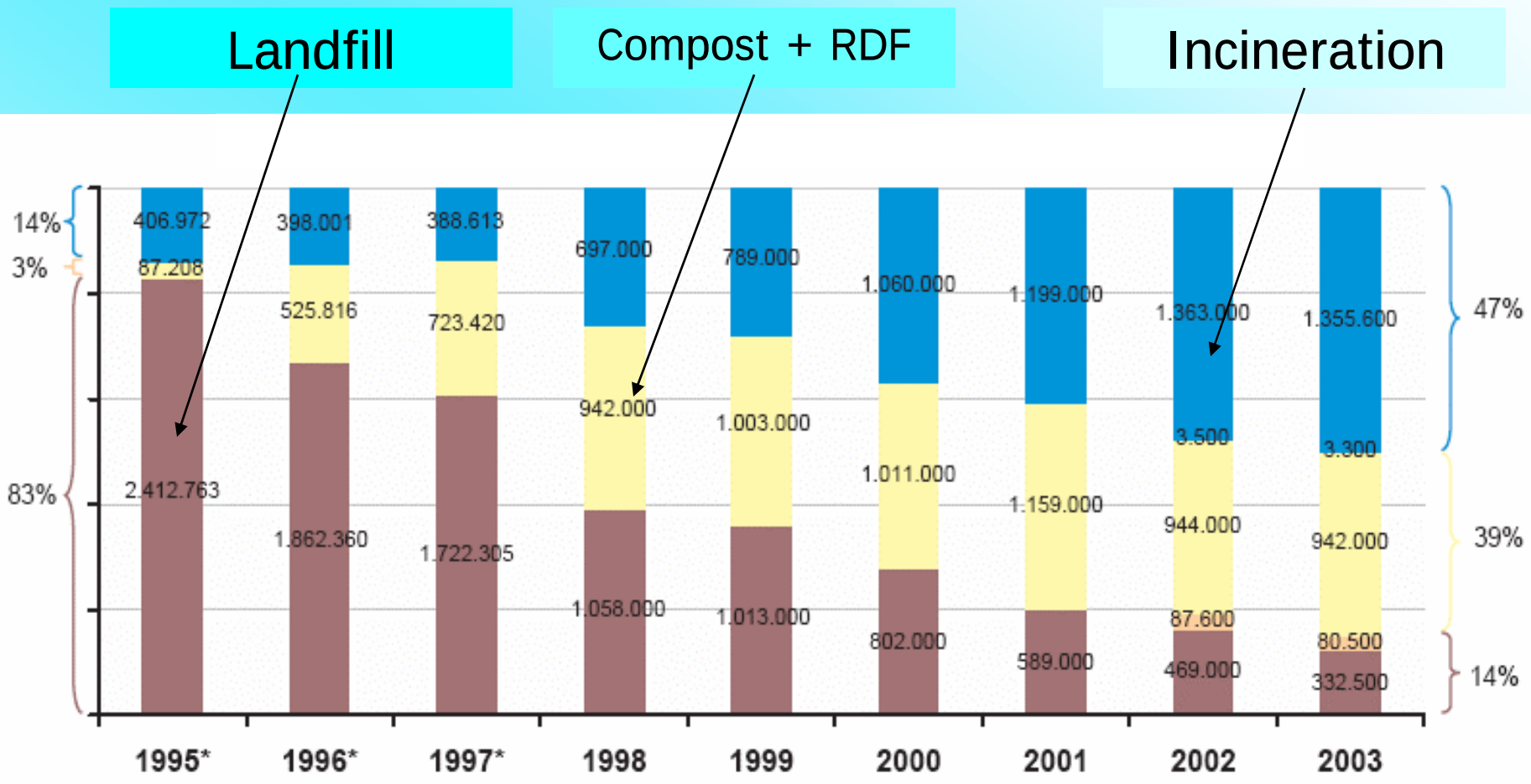
WASTE MANAGEMENT

Lombardia Region (1995-2003)



* i dati 1995-1997 sono desunti dalle relazioni a cura della Regione Lombardia

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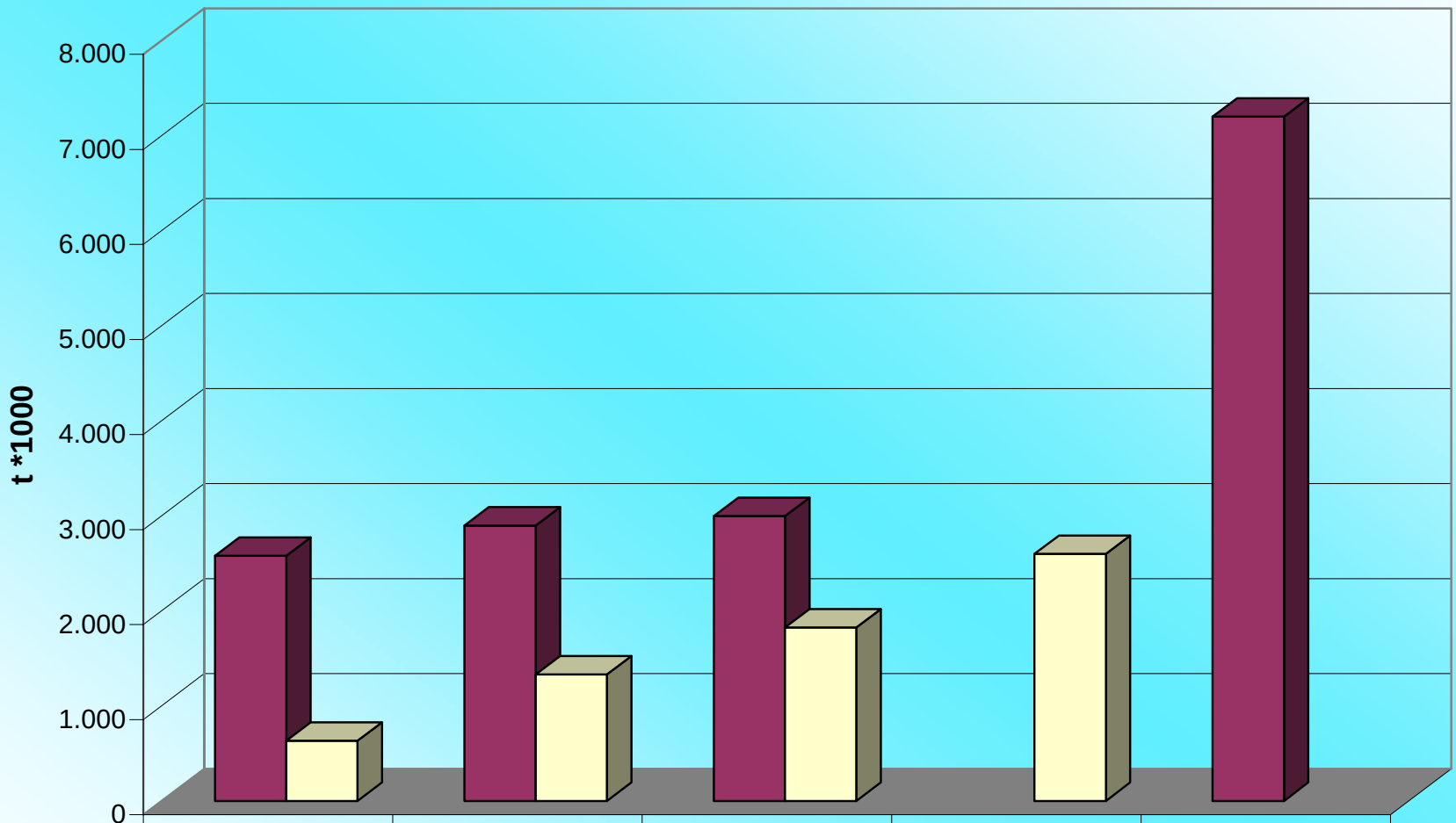
WASTE MANAGEMENT

Waste incinerated and RDF production



	2000	2001	2002	2005 (expected)	2007 (expected)
Waste incinerated	2.579	2.898	2.996		7.200
RDF production	632	1.332	1.824	2.600	

Source: APAT-ONR, 2003

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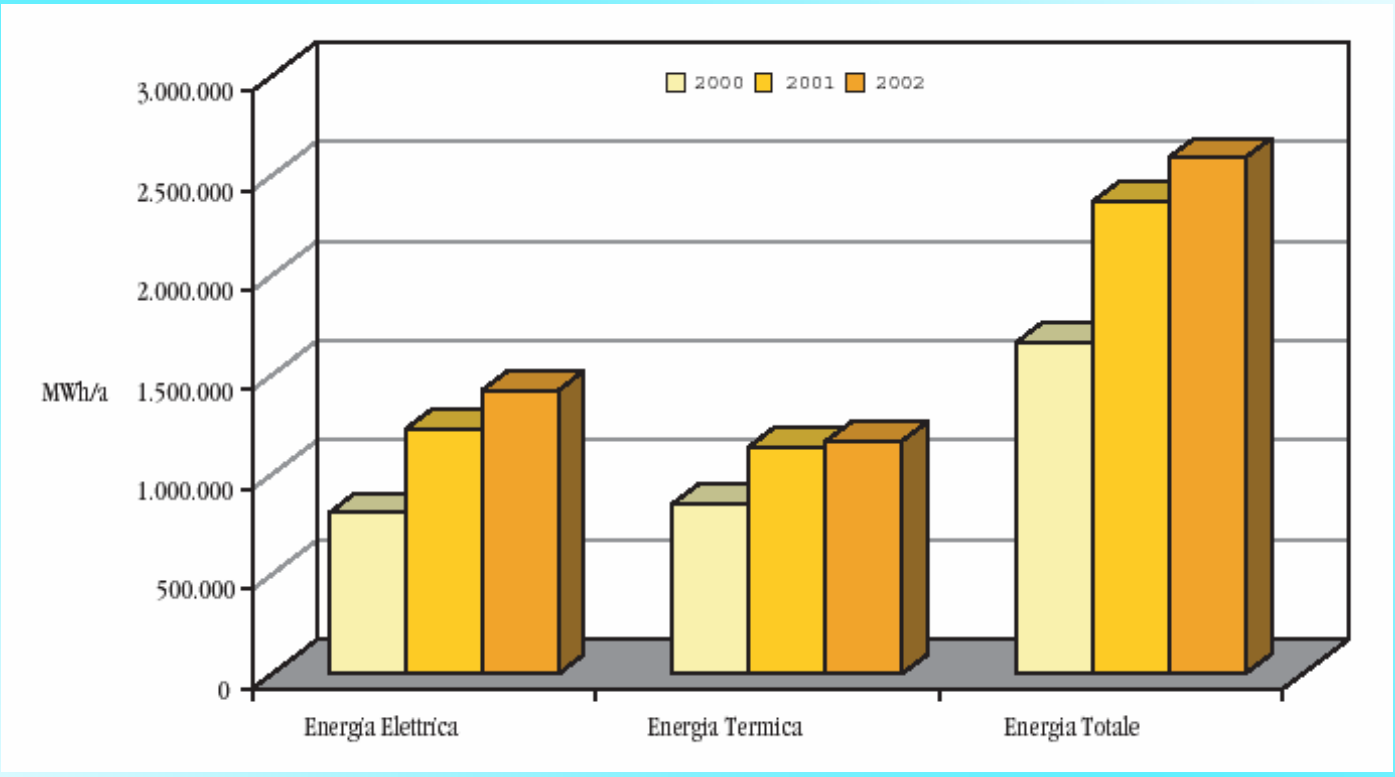
WASTE MANAGEMENT

Energy recovery from WTE plants

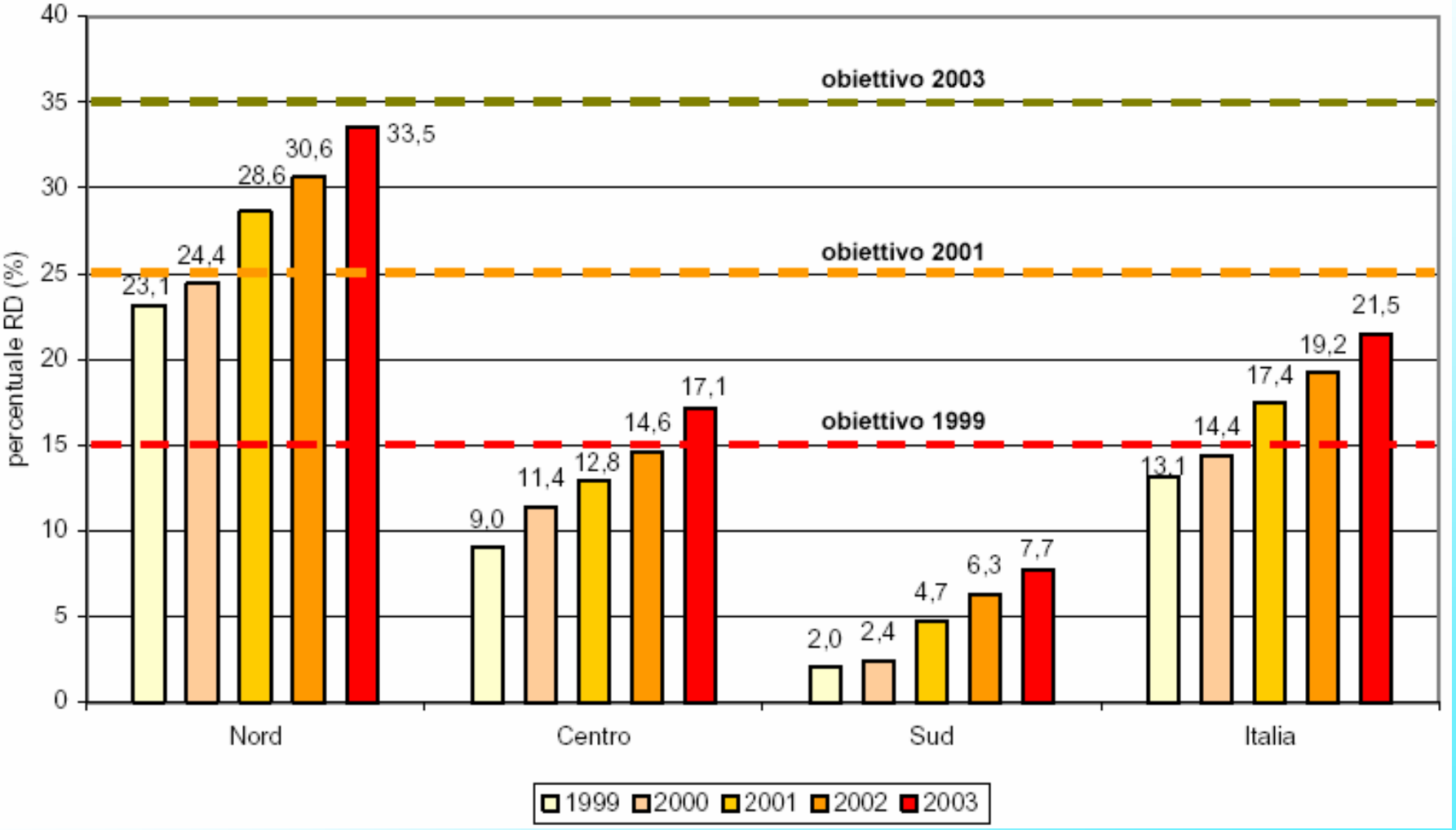


Year	kWh_{el}/t_{MSW}	kWh_{th}/t_{MSW}
2000	341	360
2001	448	415
2002	494	404

Source: APAT-ONR, 2003

SOURCE SEPARATION

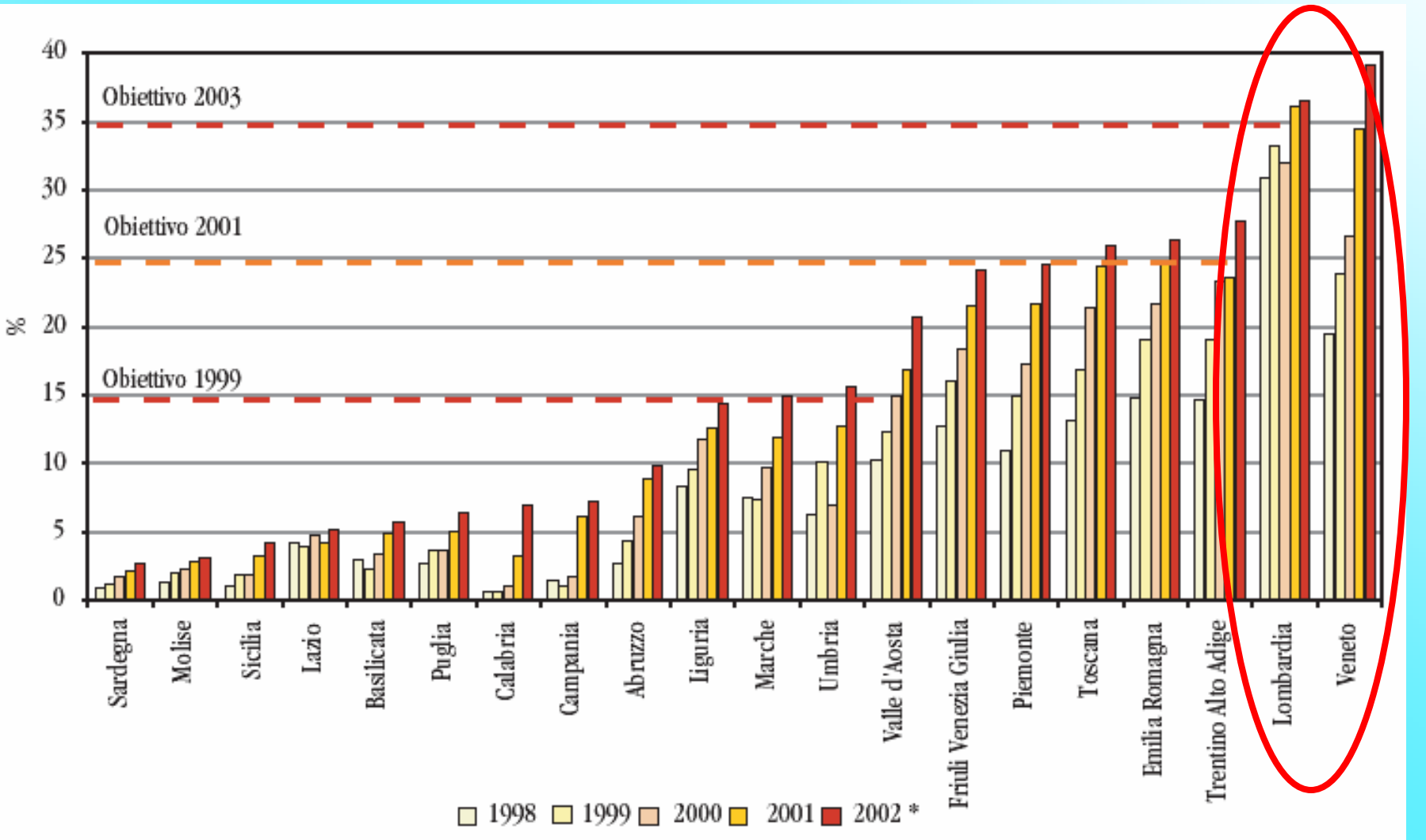
Targets for material recycling



SOURCE: Waste Report 2004, NWO

SOURCE SEPARATION

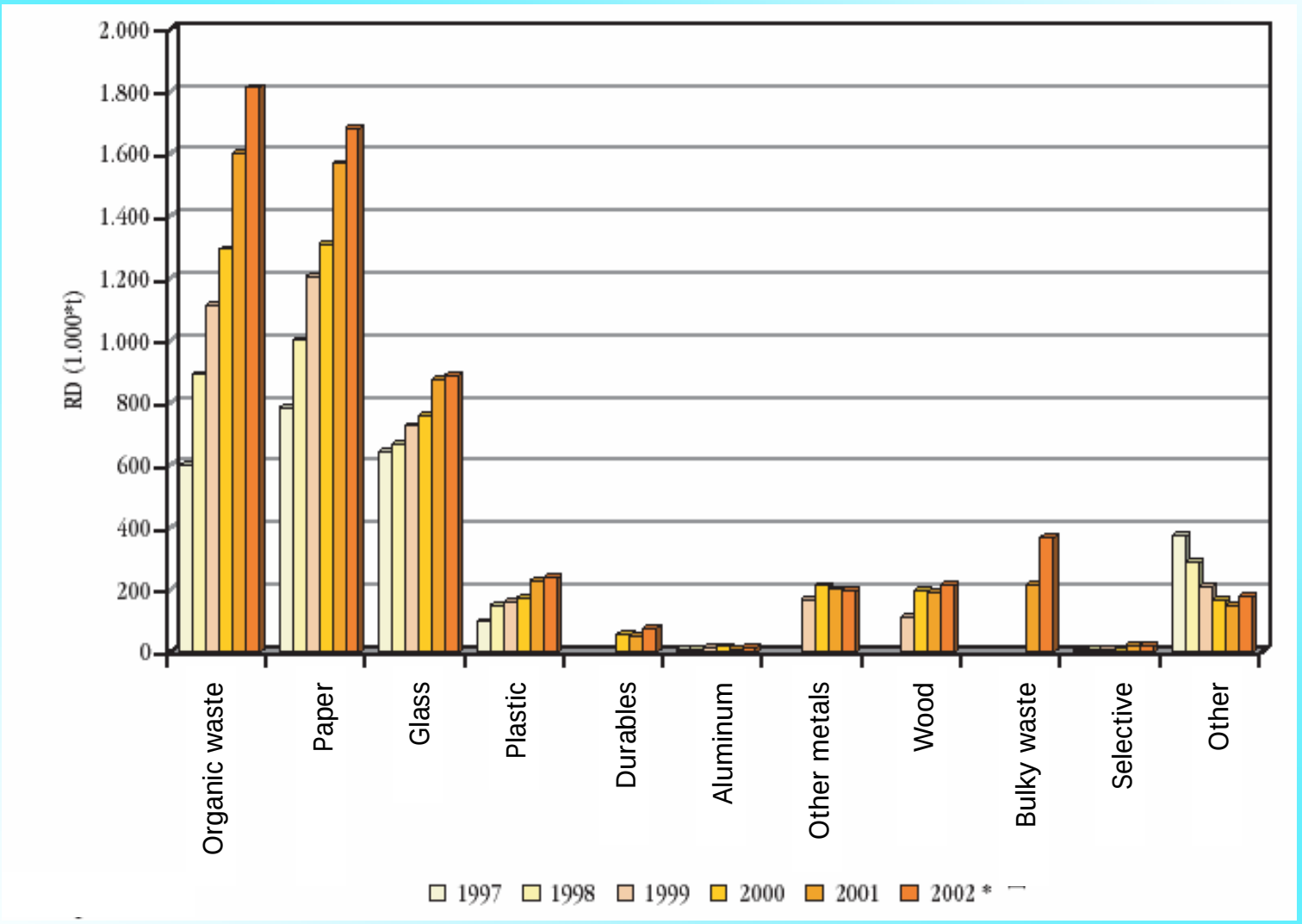
Regional breakdown



SOURCE: Waste Report 2003, APAT

SOURCE SEPARATION

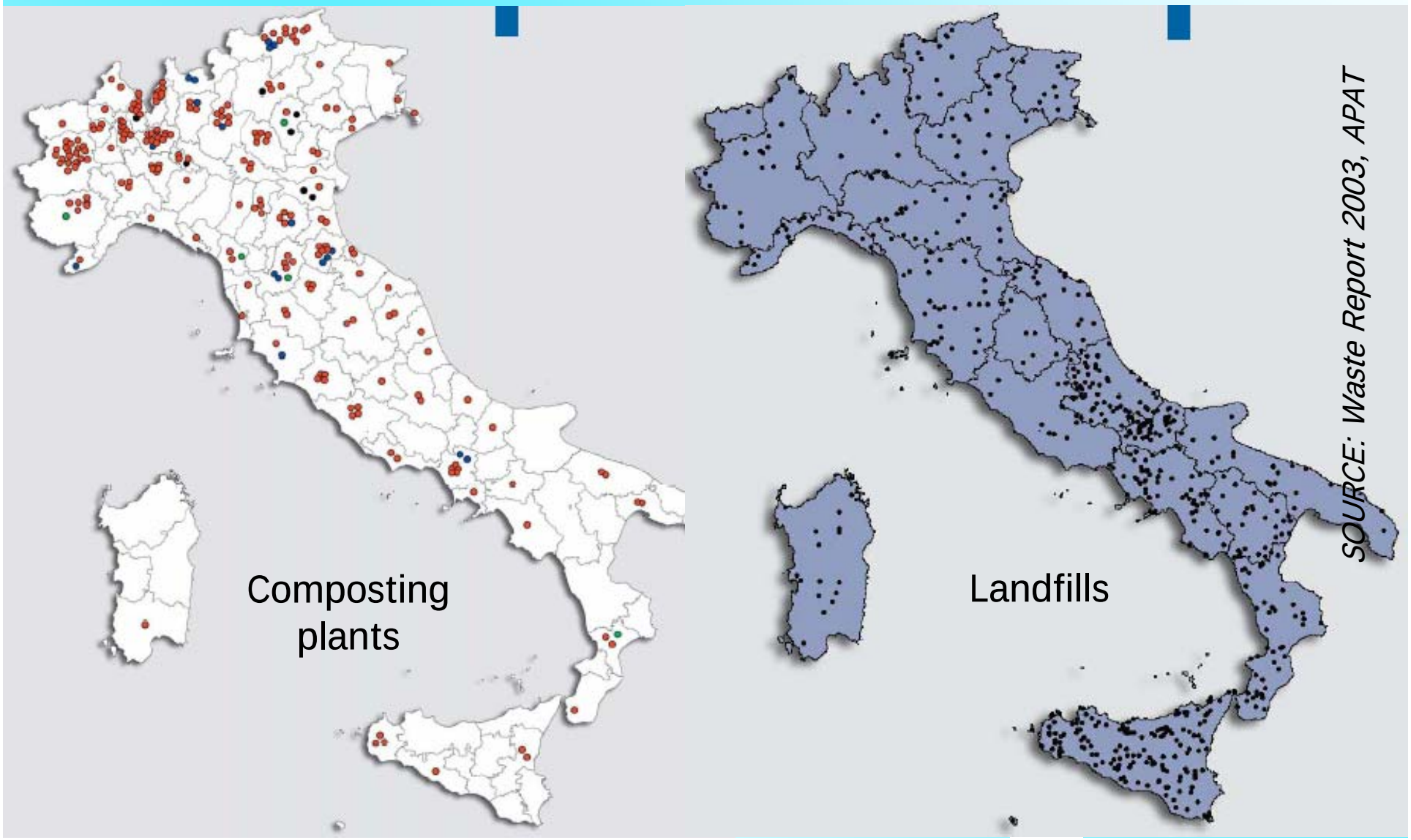
Types of materials recovered via recycling



SOURCE: Waste Report 2003, APAT

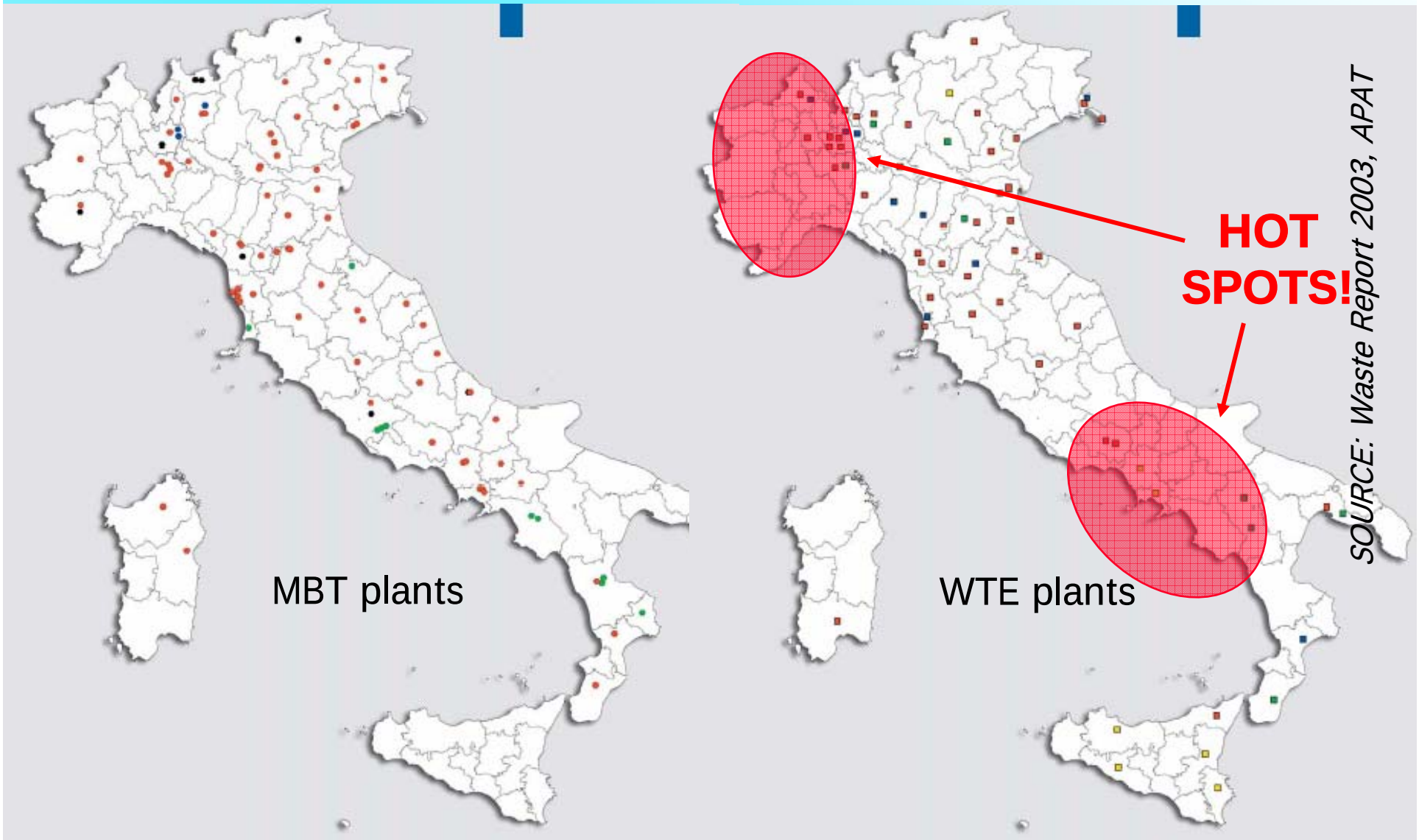
WASTE TREATMENT / DISPOSAL PLANTS

Composting plants and landfills



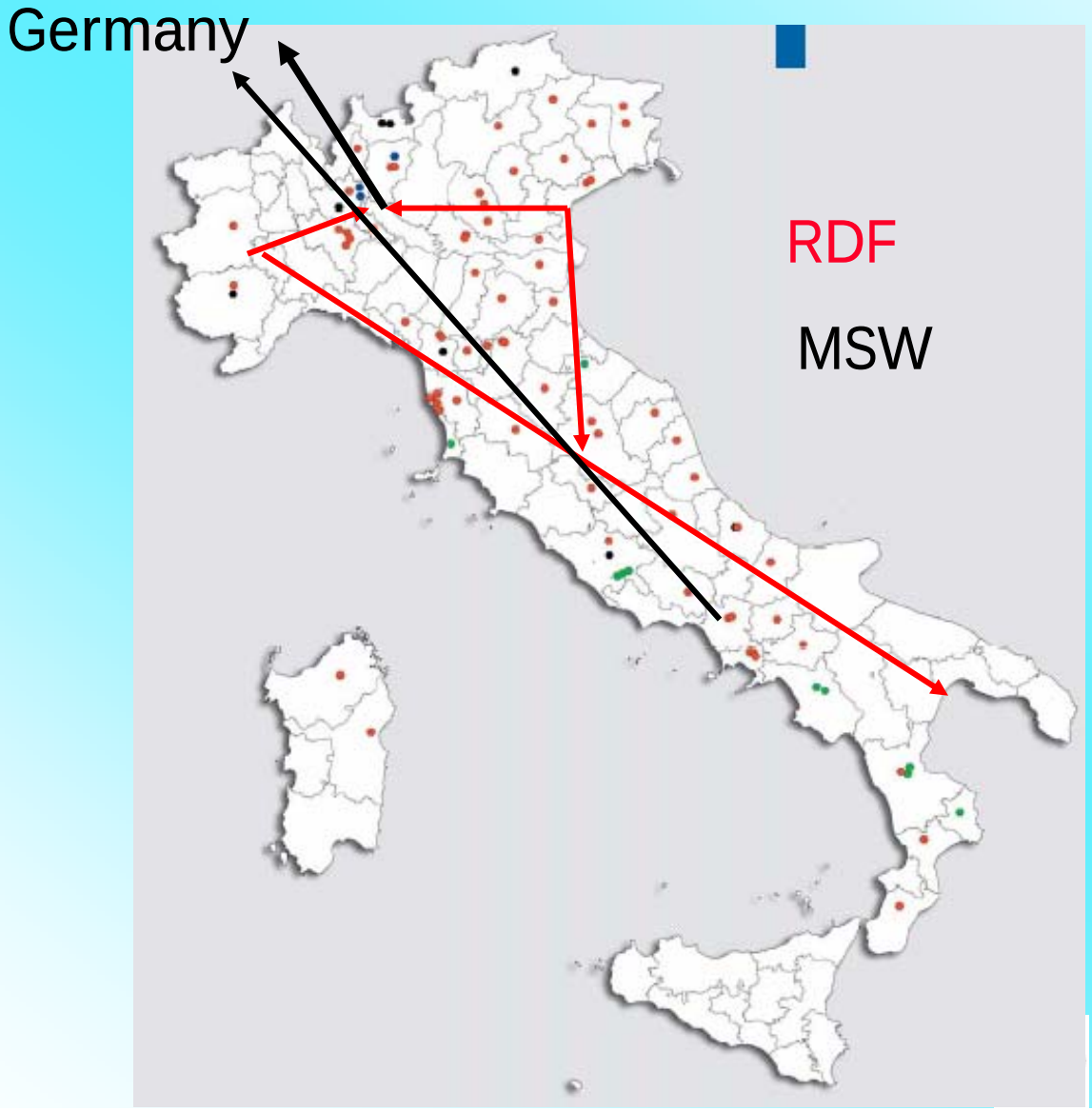
WASTE TREATMENT / DISPOSAL PLANTS

MBT and WTE plants



WASTE TREATMENT / DISPOSAL PLANTS

MSW and RDF fluxes



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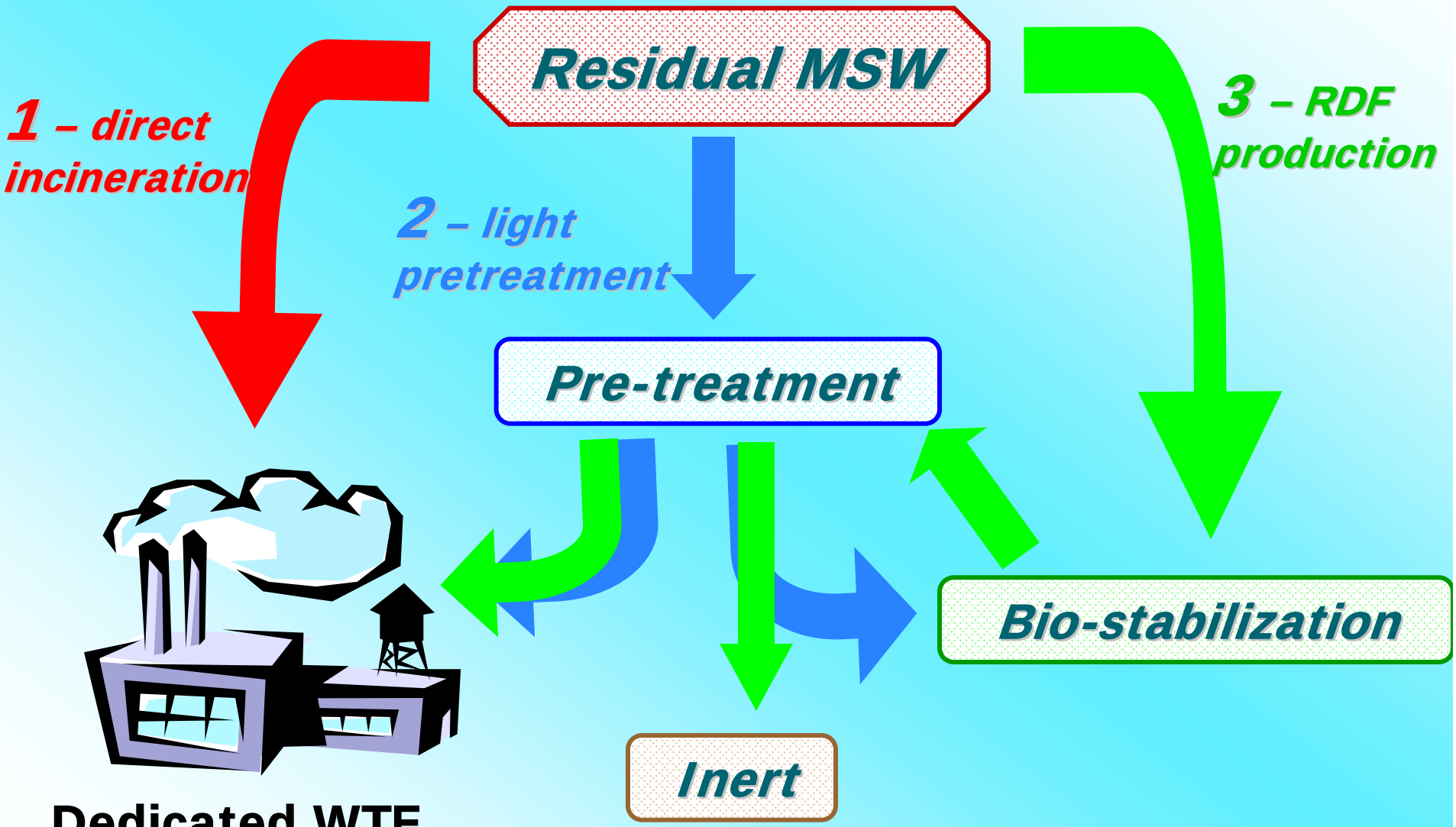
ENERGY RECOVERY FROM WASTE

The following options are currently being considered



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WTE PLANTS

Some plants recently come in operation

DRY FLUE GAS TREATMENT

- Brescia WTE plant (ASM) → residual waste
- Milano WTE plant (AMSA) → "light" pretreatment
- Dalmine WTE plant (REA) → residual waste
- Bergamo fluidized bed combustor (BAS) → RDF
- Corteolona fluidized bed combustor (Ecodeco) → RDF

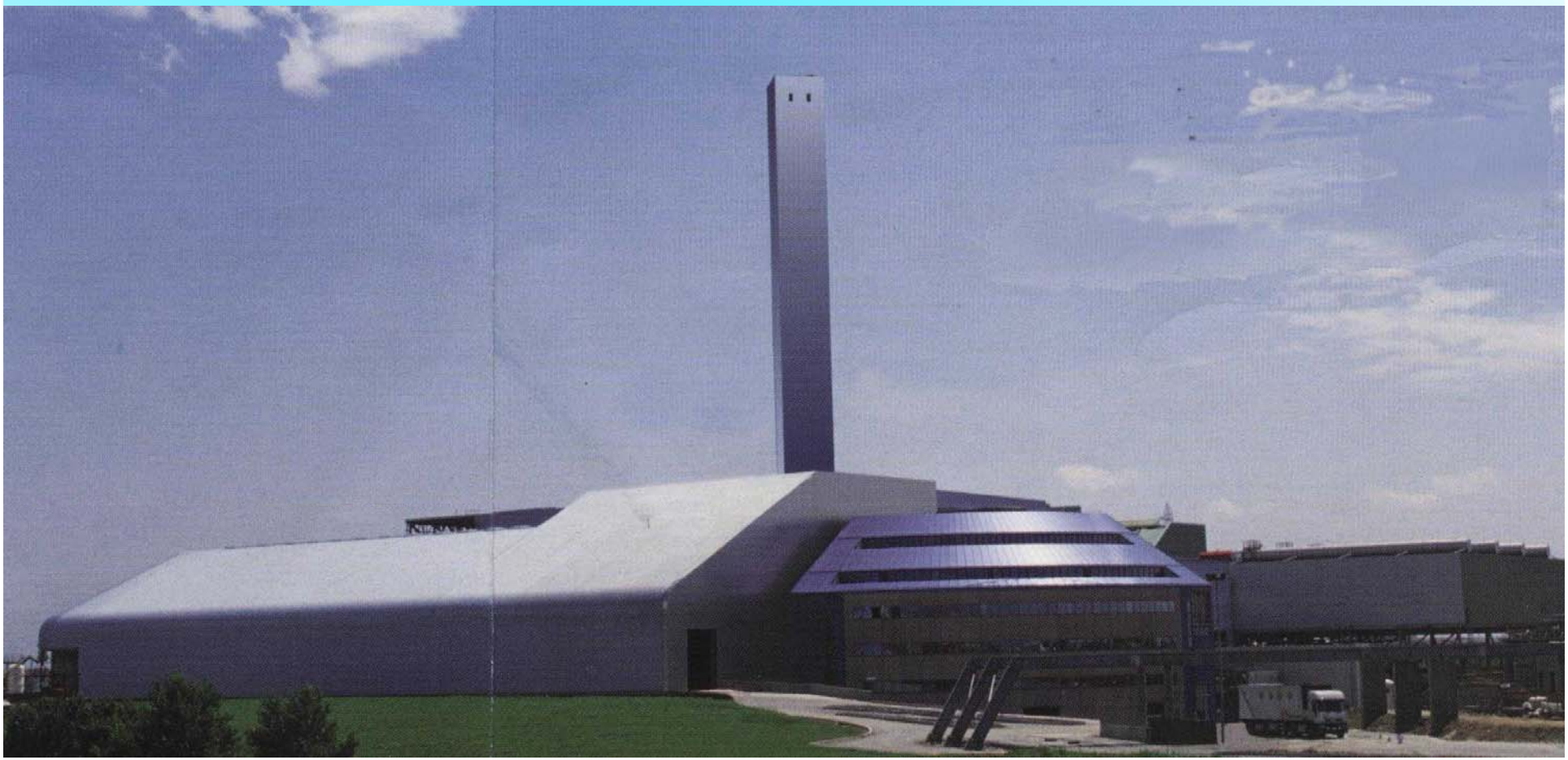
SEMI-DRY or WET, with no liquid discharge (hybrid)

- Busto Arsizio WTE plant (ACCAM) → residual waste
- Trezzo WTE plant (PRIMA) → residual waste + RDF

WTE PLANTS

The Brescia WTE plant

- 3 lines (grate furnaces), 1 for biomass
- district heating



WTE PLANTS

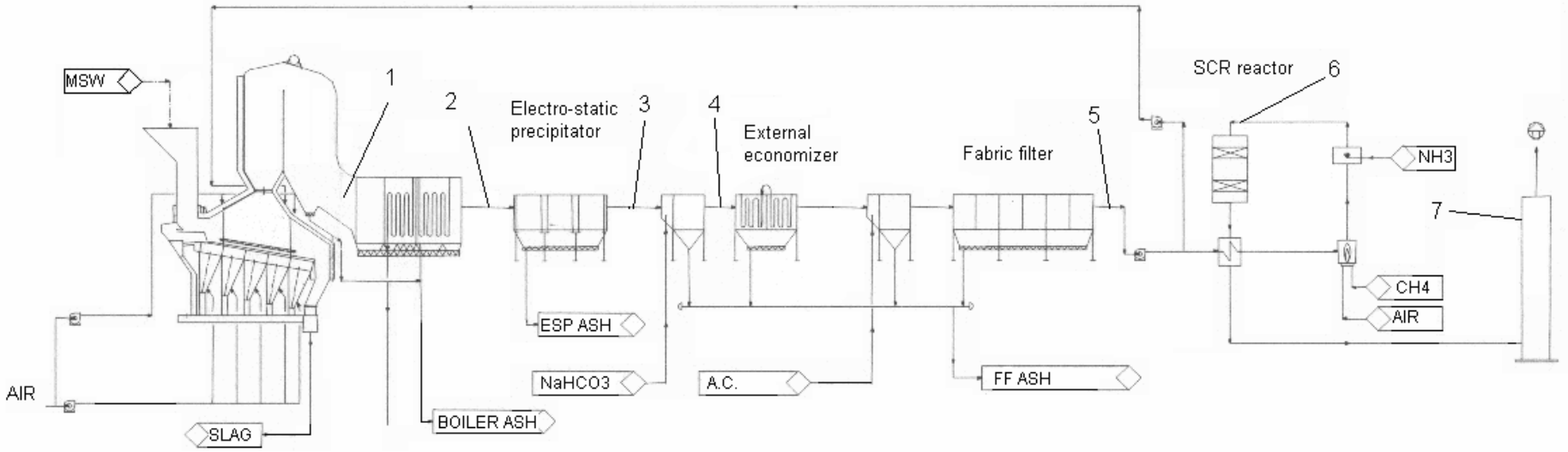
The Milano WTE plant

- 3 lines (grate furnaces)
- max. treatment capacity: 60,4 t/h
- steam production: 225 t/h
- steam pressure: 52 bar
- steam temp.: 440°C
- net LHV efficiency: 28%
- net electric power: 51 MWel
- thermal power: 68 MW (for district heating)

WTE PLANTS

Dalmine plant

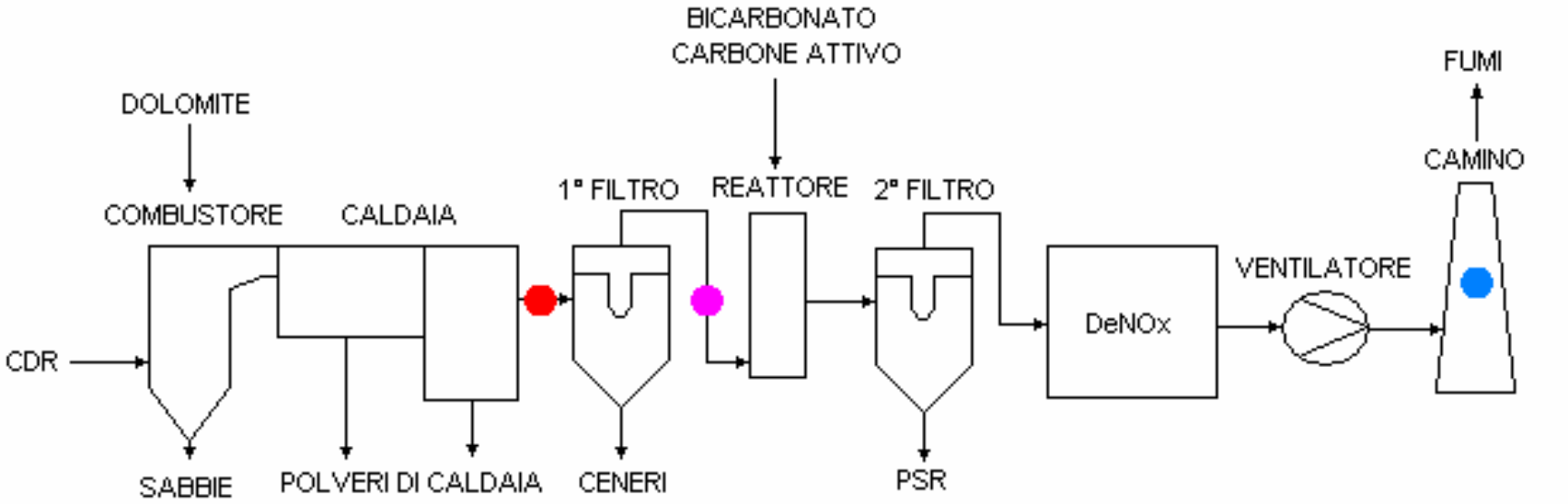
- ✓ Sodium bicarbonate + activated carbon
- ✓ SCR reactor for NO_x removal



WTE PLANTS

Bergamo plant

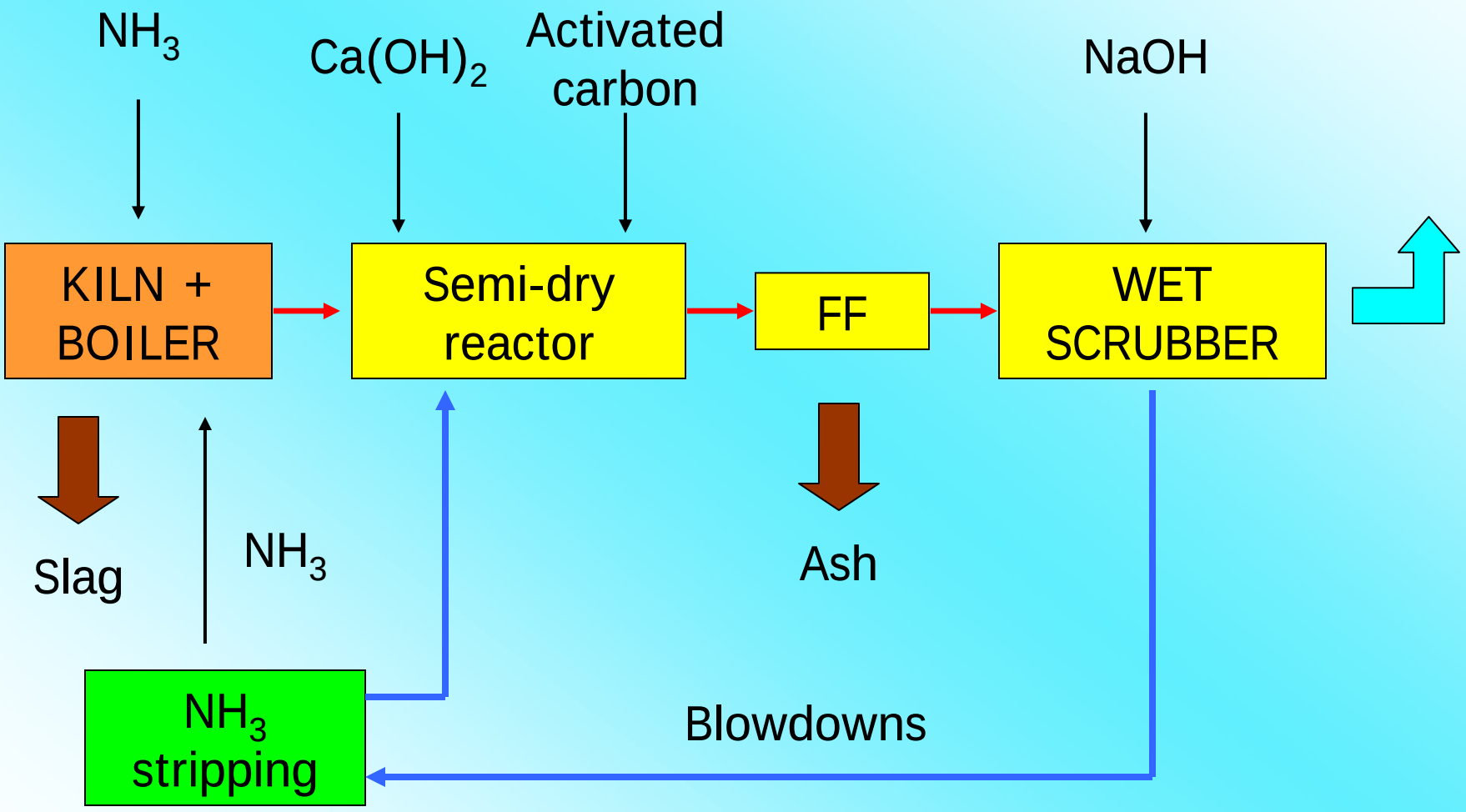
- ✓ Fluidized bed furnace (bubbling)
- ✓ double filtration with two fabric filters
- ✓ low-temperature SCR reactor (no reheating required)



Identificazione dei punti di prelievo:
- filtro ceneri (a monte di tutto il Settore Trattamento Fumi)
- a valle del filtro ceneri (punto "a monte" del Settore con interferenza di polveri accettabile per le misure)
- a camino (a valle del Settore Trattamento Fumi)

WTE PLANTS

Hybrid flue gas treatment system



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WTE PLANTS

Average atmospheric emissions (mg m^{-3} dry, @11% O_2)

	Observed values	**EU Directive 2000/76**
CO	1 – 5	**50**
TSP	0.3 – 0.5	**10**
HCl	0.2 – 3	**10**
HF	0.01 – 0.05	**1**
SO_2	0.3 – 1.5	**50**
NO_x	20 – 70	**200**
Cd	0.00001 – 0.0005	**0.05**
Hg	0.0001 – 0.007	**0.05**
Pb	0.0004 – 0.0006	**0.5**
PCDD/F (I-TEQ) (*)	0.001 – 0.03	**0.1**

(*) ng m^{-3}

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WTE PLANTS

Stack monitoring campaigns at the Milano WTE plant (mg m^{-3} dry, @11% O_2)

	Campagna I	Campagna II	Campagna III	Campagna IV	Campagna V	BREF Waste Incineration	2000/76/EU
HCl	7.13	7.32	7.7	7.05	7.37	1 – 8	10
NO_x	136.32	139.59	142.8	135.36	143.6	120 – 180	200
CO	7.20	8.03	5.88	9.89	10.3	5 – 30	50
NH_3	4.57	5.03	4.34	5.78	5.84	< 10	10
SO_2	0.66	1.42	1.91	2.22	3.04	1 – 40	50
TOC	0.307	0.263	0.322	0.304	0.53	1 – 10	10
TSP	0.16	0.133	0.159	0.149	0.13	1 – 5	10
PAH	0.0001	0.0000006	0.0000014	0.0000031	0.0000017		0.01
PCB	0.0000012	0.0000008	0.0000006	0.0000014	0.0000012		0.1
(Cd +Tl)	0.000267	0.000233	0.00227	0.001267	0.0014	0.005 – 0.05	0.05
Hg	0.0021	0.0021	0.00194	0.00156	0.0032	0.001 – 0.02	0.05
(Pb+Sb+As+Cr+ Co+Cu+Mn+Ni+V+Sn)	0.00005	0.00081	0.00331	0.004243	0.00268	0.005 – 0.5	0.5
PCDD/F ($ngTEQ/m^3$)	0.00133	0.00217	0.00163	0.001427	0.0013	0.01 – 0.1	0.1

Despite very interesting emission values, a major revamping is foreseen for 2007 (concerns for HCl, NO_x, NH_3)

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WTE PLANTS

Electrical and thermal energy production, yearly average
(Milano WTE plant)

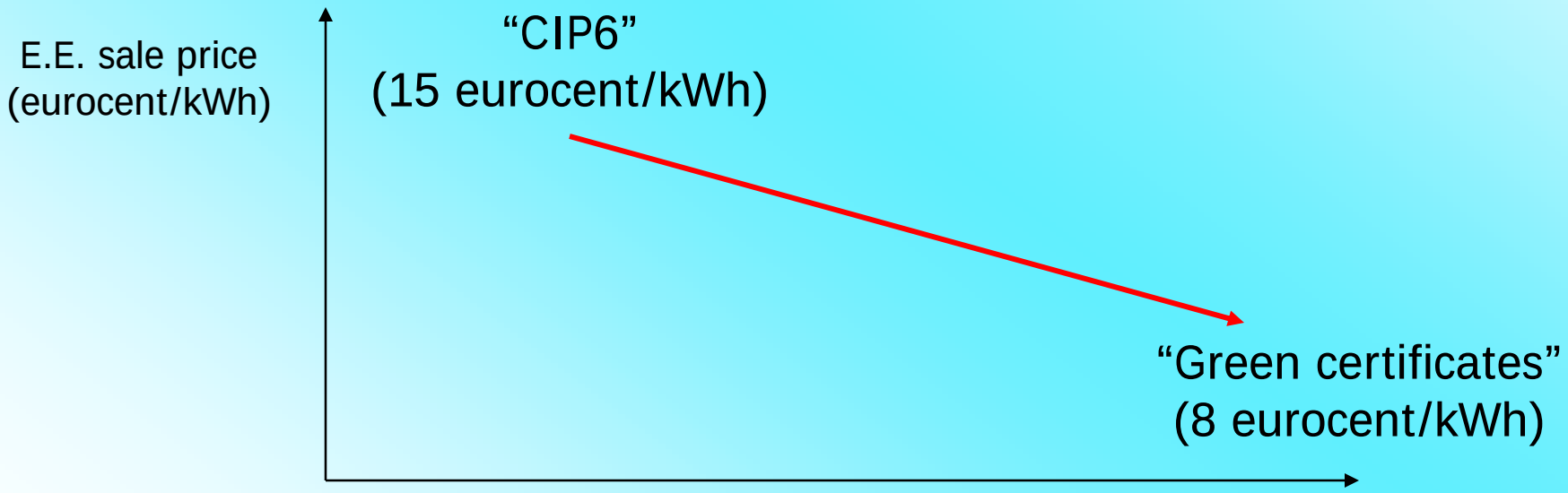
kWh per ton of feedstock (electrical)	**742 – 790**
kWh per ton of feedstock (thermal)	**24 – 342**
Net LHV efficiency (electrical)	**22,9 – 25,8 %**
Net LHV efficiency (thermal)	**0,8 – 10,4 %**

WTE PLANTS

Perspectives in Italy

Two major concerns:

- ✓ social acceptability of new plants (NIMBY syndrome)
- ✓ financial sustainability of the investment

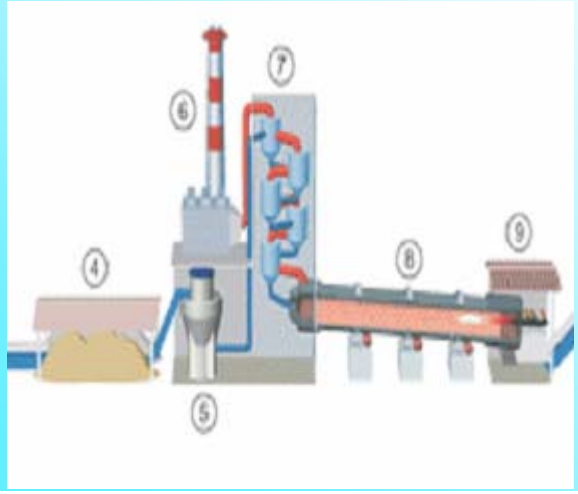


- ✓ "white certificates" for thermal energy??

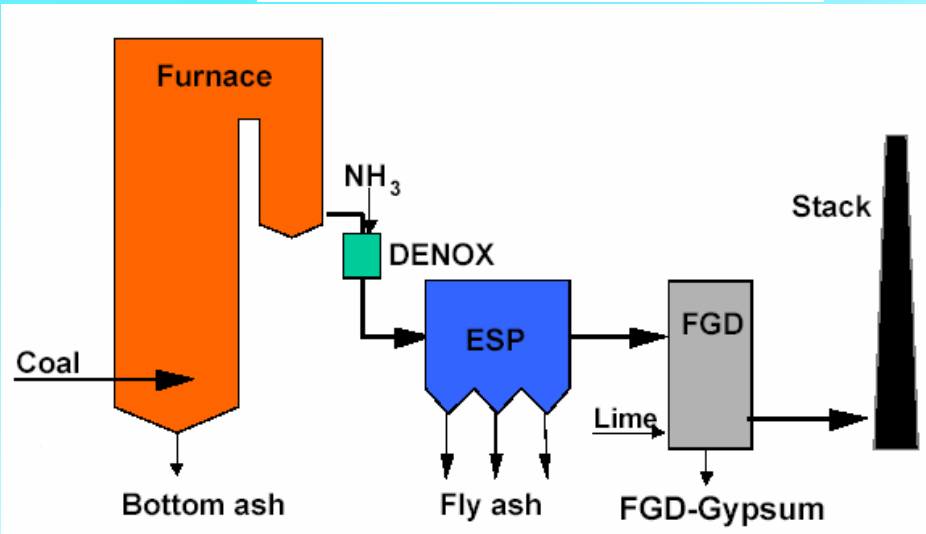
ENERGY RECOVERY FROM WASTE

RDF production and its co-combustion in industrial plants

- option strongly supported by the EU
- only few experiences in Italy in
  - ✓ **cement kilns**



  - ✓ **coal fired power plants**



ENERGY RECOVERY FROM WASTE

Dedicated WTE plants vs. RDF co-incineration

Theoretical RDF treatment capacity

CEMENT KILNS	POWER PLANTS
350.000 – 700.000 t/y	1.600.000 – 3.200.000 t/y

→ 10 to 18% of the total waste production

Economic aspects

✓ In order to be competitive with direct incineration in large scale WTE plants, it is necessary to get paid for the RDF by the final user

✓ RDF co-incineration is more attractive when compared with small-scale WTE plants, characterized by higher specific cost and lower efficiency; in this case a fee for RDF disposal can be economically sustainable

RESEARCH ACTIVITY AT DIIAR

Experimental

- Assessment of the environmental performances of MSW incineration plants
  - Stack emissions (gas-solid partitioning)
  - Removal efficiency in the flue gas cleaning system
  - Contamination of solid and liquid residues (implication on their management and final disposal)
  - Evaluation of the total release in the environment (EU IPPC Directive)
  - PCDD/F formation and removal
  - PCDD/F release in the environment
  - PCDD/F and heavy metals mass balance
  - Role of the APC technology → BAT

RESEARCH ACTIVITY AT DIIAR

Modelling

- Stack dispersion modelling
- Emission inventories (MSW incinerators, landfills)
- Estimate of the avoided emissions (power plants, household boilers)
- Life Cycle Assessment (LCA)
- Waste pre-treatment (RDF production) modelling
  - Mass balances
  - Energy balances
  - Energy consumption
  - Air emissions
  - Carbon fluxes (global warming)
- Health risk assessment

RESEARCH ACTIVITY

Dioxin fluxes and mass balances in WTE plants

It is not clear whether **overall limits for PCDD/F release into the environment** will be set (IPPC Directive, Japan Guidelines), still for such compounds the combustion and flue gas control technologies adopted in MSWI plants play a major role in determining the actual release and thus the role of the plant as a dioxin "producer" or a dioxin "destroyer"

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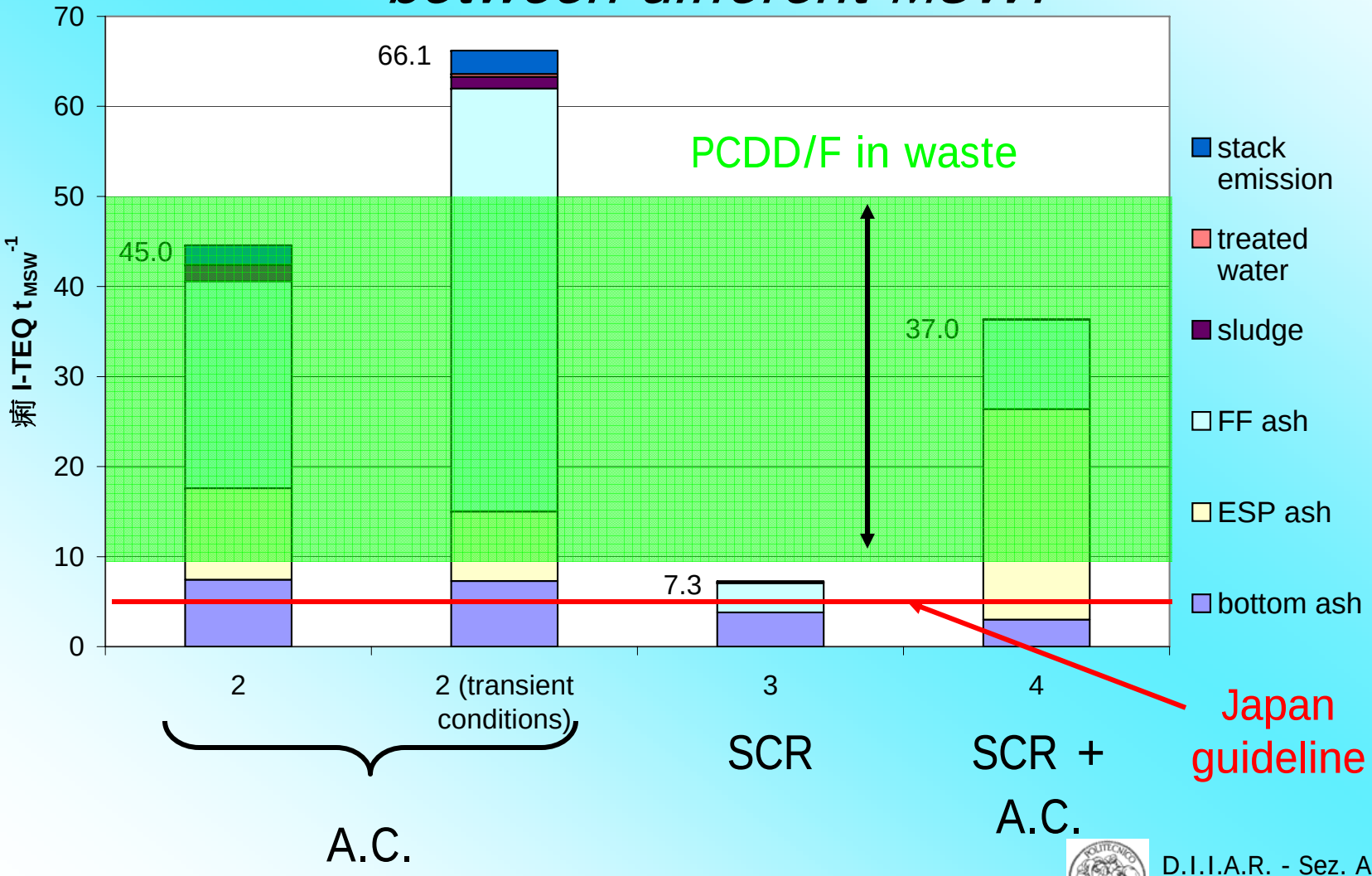
RESEARCH ACTIVITY

Mass flows into the environment – comparison between different MSWI



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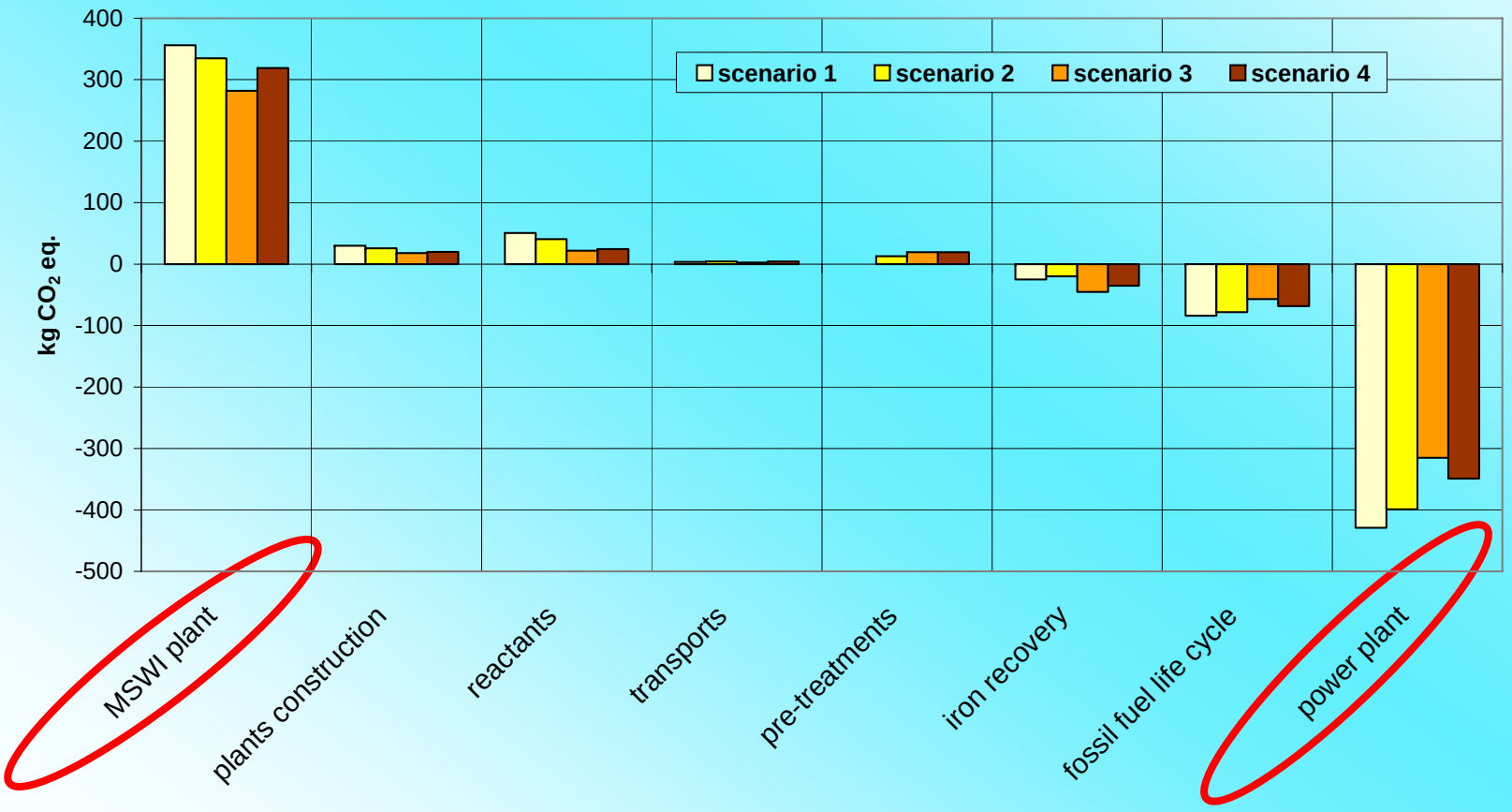
RESEARCH ACTIVITY

LCA applied to four different waste management strategies

GWP: role of the different processes



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Politecnico di Milano

D.I.I.A.R. – Environmental section research staff

Atmospheric Pollution and Solid Waste Management Group

- 1 Full Professor (M. Giugliano)
- 1 Associate Professor (S. Cernuschi)
- 2 Full time Researchers (M. Grosso and G. Lonati)
- 2 Ph.D. Students (C. Pastorello and L. Rigamonti)
- 1 Senior contract researcher (S. Caserini)
- 2 Junior contract researchers (E. Palini and S. Casadei)