UPSWING Process

- the Combination of an Incinerator and a Power Plant -

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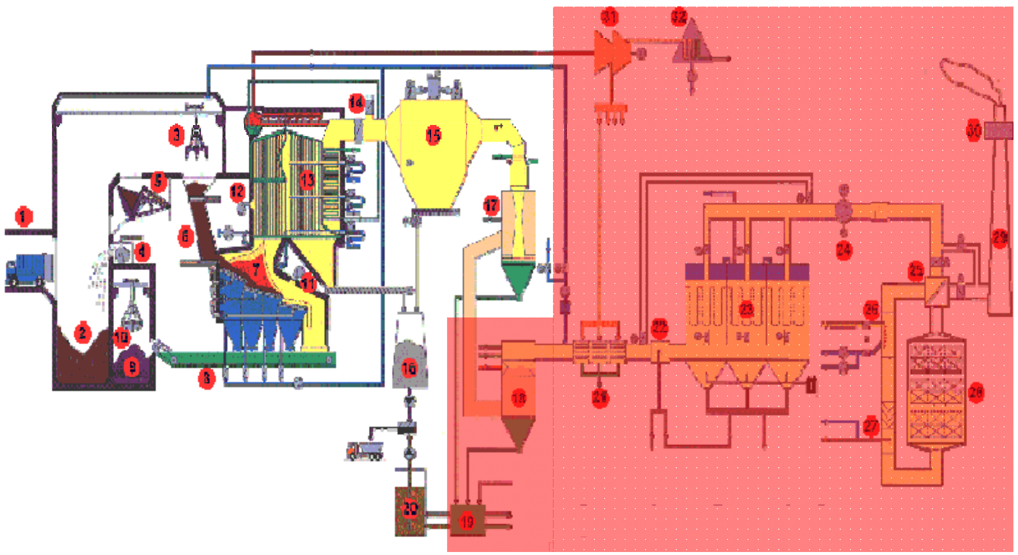


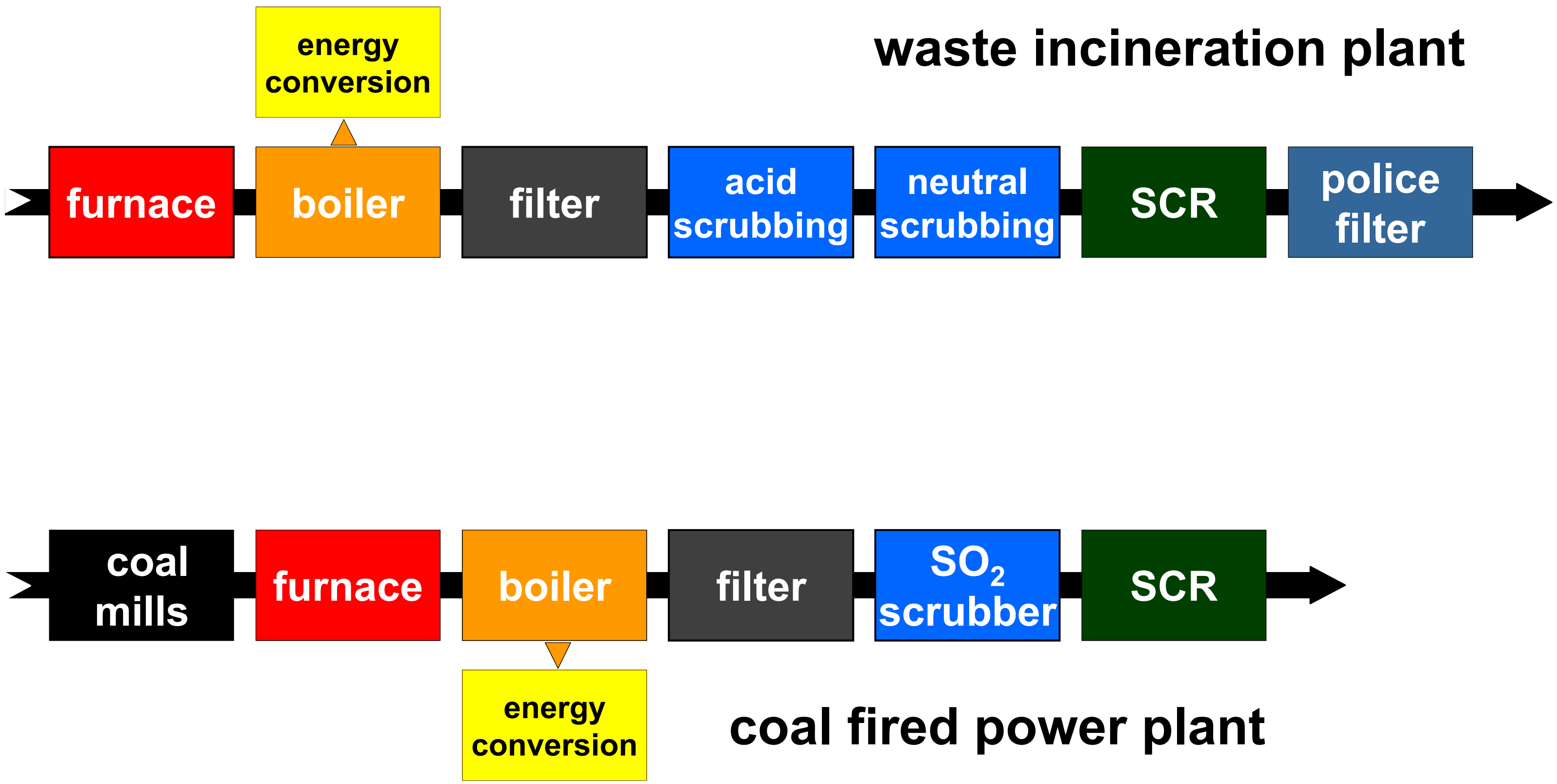
actual tendencies in WtE processes

- improving energy efficiency
- improving material recovery
- simplifying technology
- reducing costs

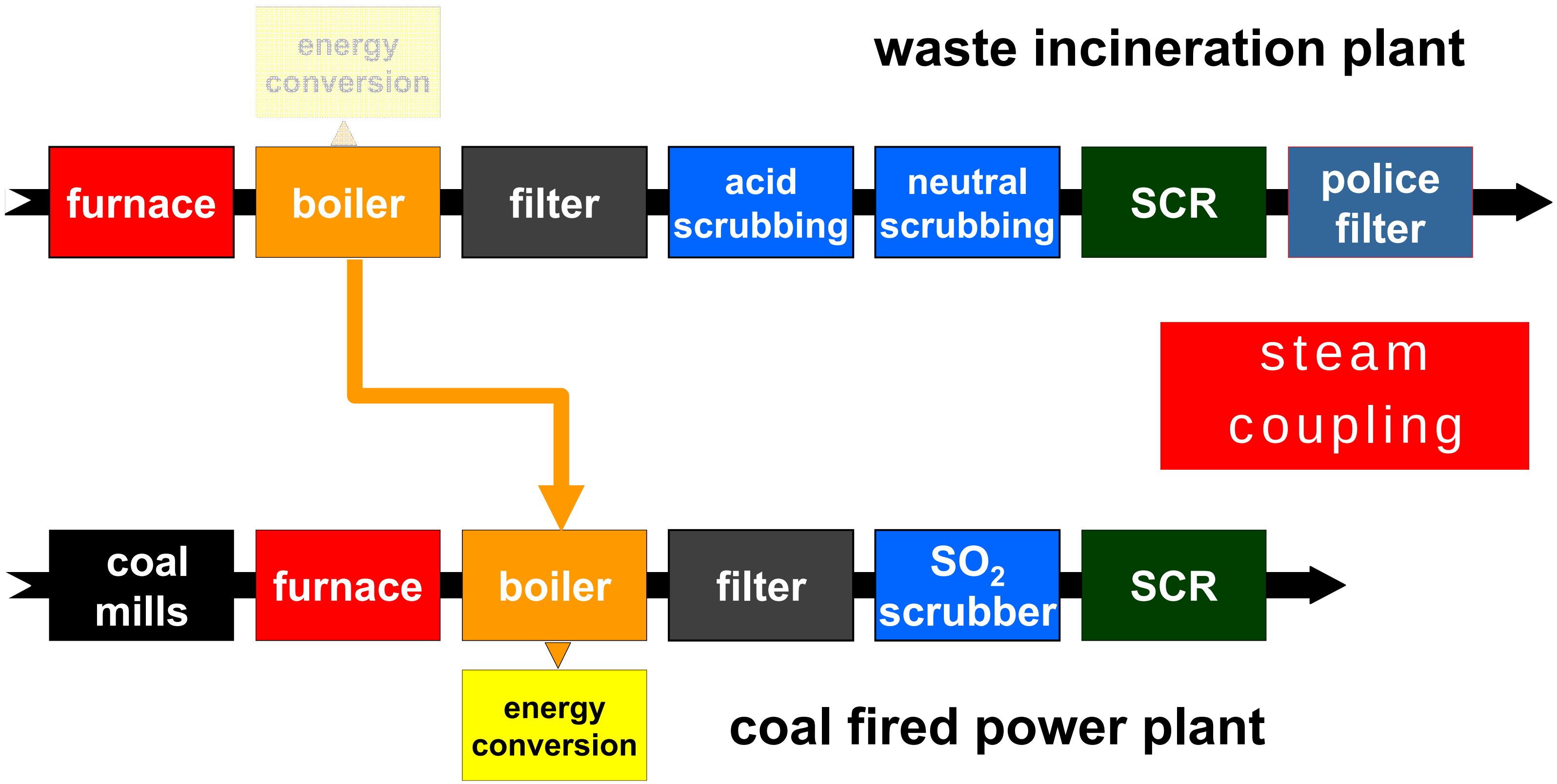
options

- combustion or co-combustion in other thermal processes (power plants, cement kilns, …)

- combination of waste incineration and coal fired power plant



options for such combination



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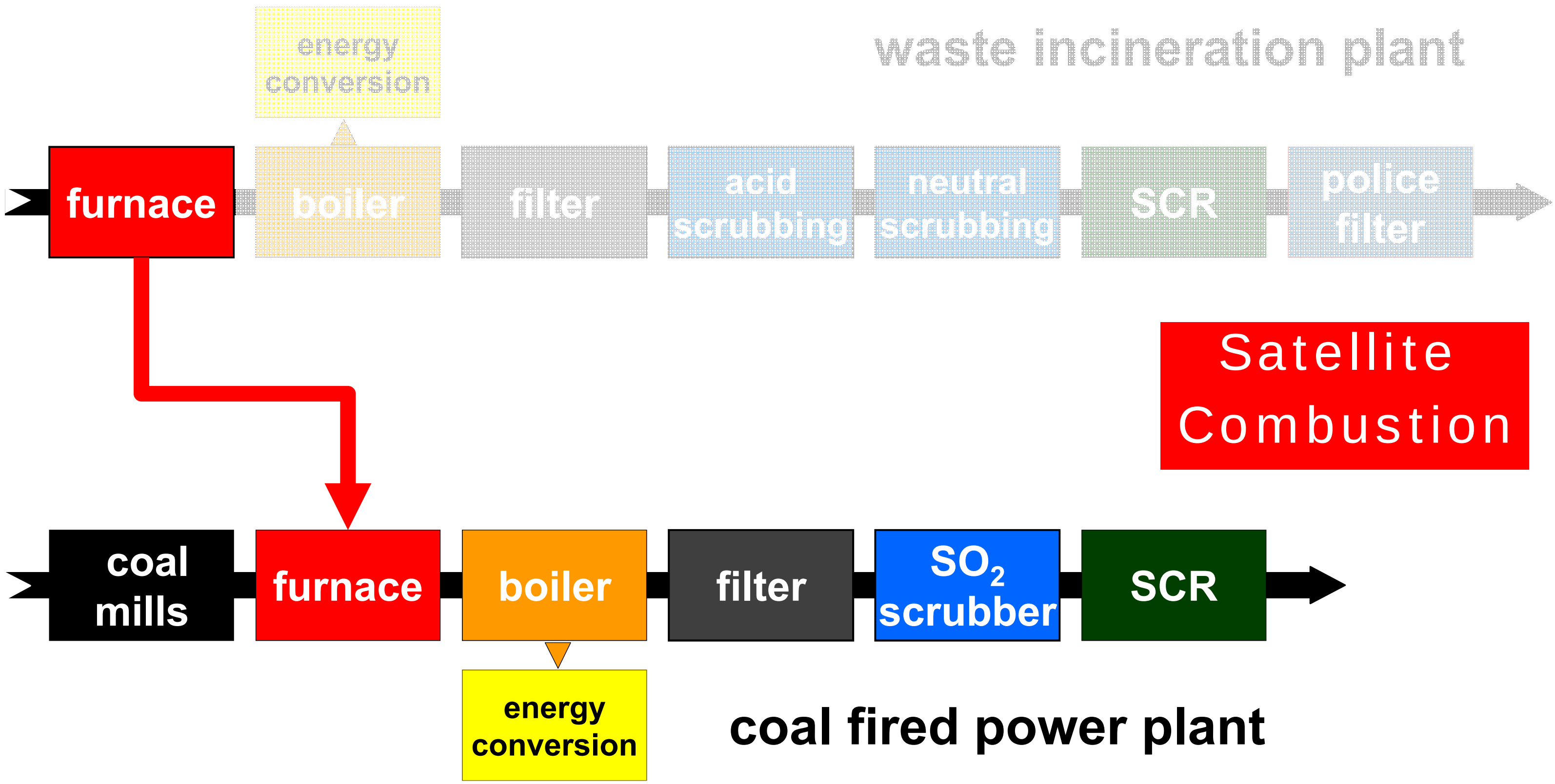

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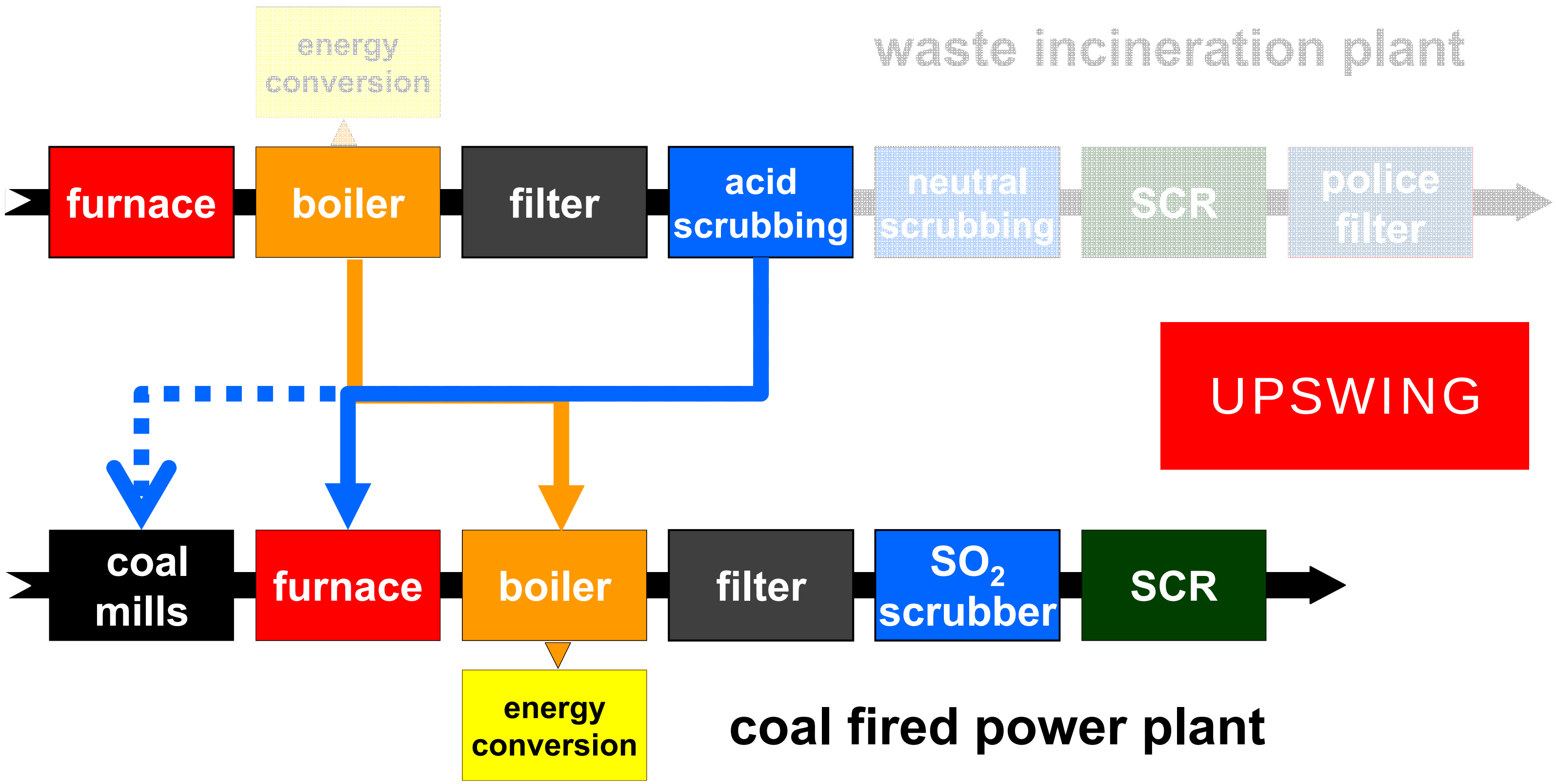

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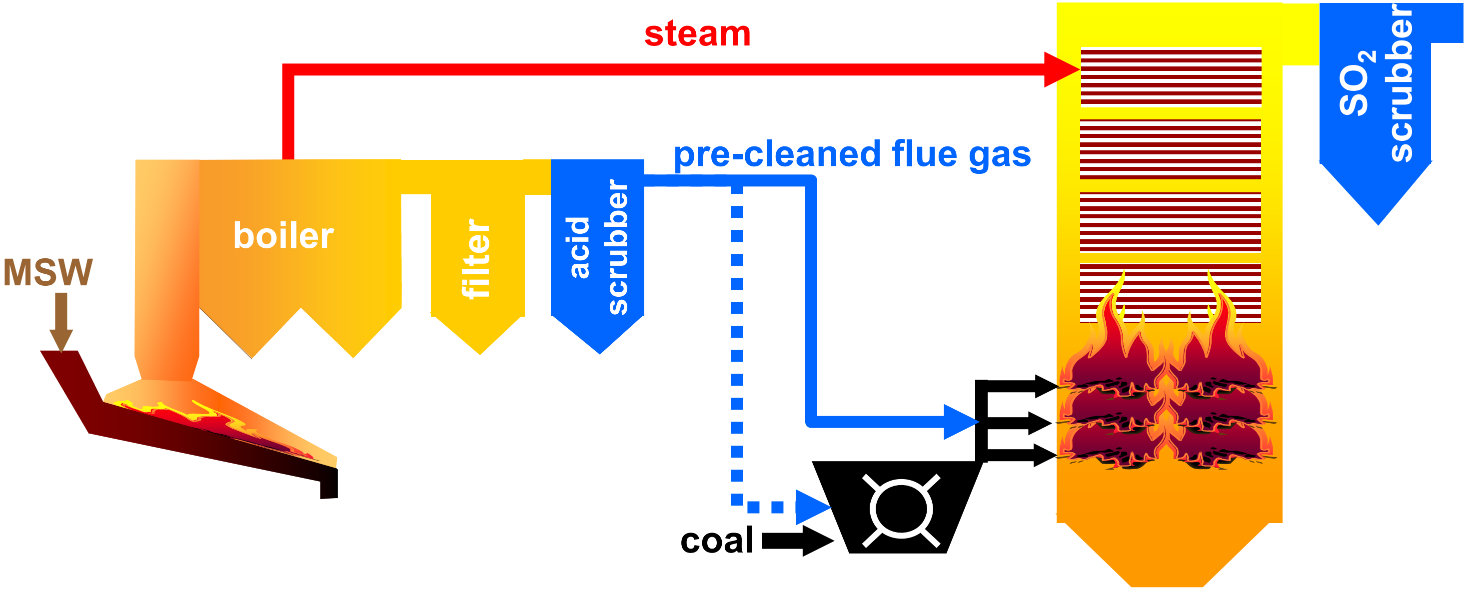


objectives: **prevent waste born pollutants from entering the power plant**

UPSWING Prozess

(Unification of Power Plant and Solid Waste INcineration on the Grate)

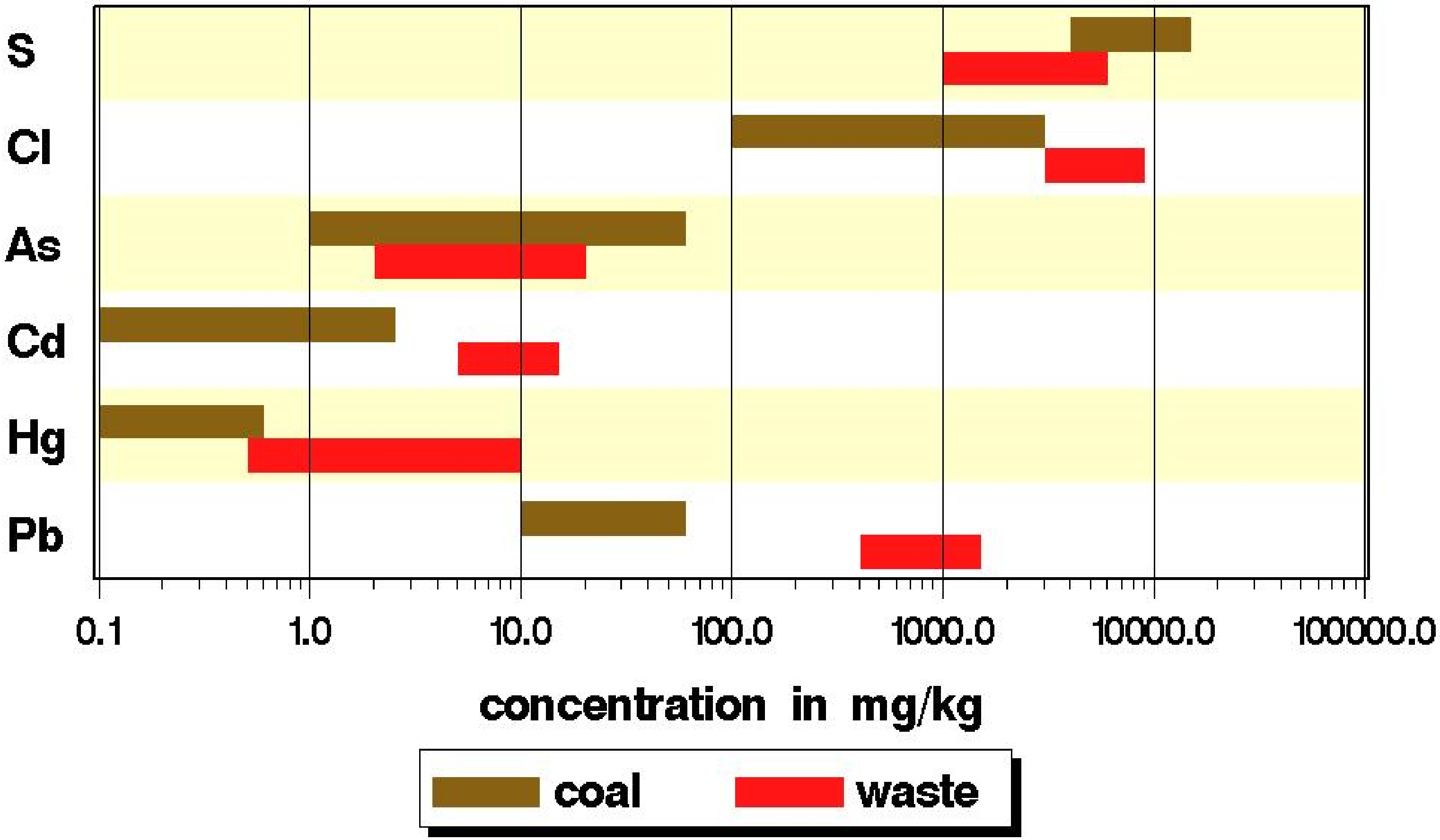
EU Project UPSWING

(ENK5-CT-2002-00697)

1 IVD Stuttgart, D (coordinator)
2 Forschungszentrum Karlsruhe, D
3 Mitsui-Babcock Energy Ltd., GB
4 KEMA, NL
5 Politechnika Wroclawska, PL
6 Elektrowna TUROW S.A., PL
7 Czech Technical University Prag, CZ
8 Skolovska Uhelna A.S., CZ
9 University ‘Politehnika‘ of Timisoara, RO
10 Institutul de Studii si Proiectari Energeti, RO
11 Technical University Sofia, BG

tasks of EU Project

- final destination of waste born pollutants
  - acid gases (HCl, SO_2, ...)
  - volatile heavy metals (Hg, Cd, Pb, ...)
  - nitrogen oxides
  - low-volatile organic pollutants (PCDD/F, ...)
- technique of coupling
  - integration of steam
  - integration of flue gas
- effects on the power plant
  - stable operation of the coal burners
  - measures in case of shut-downs
  - quality of power plant residues
- economy

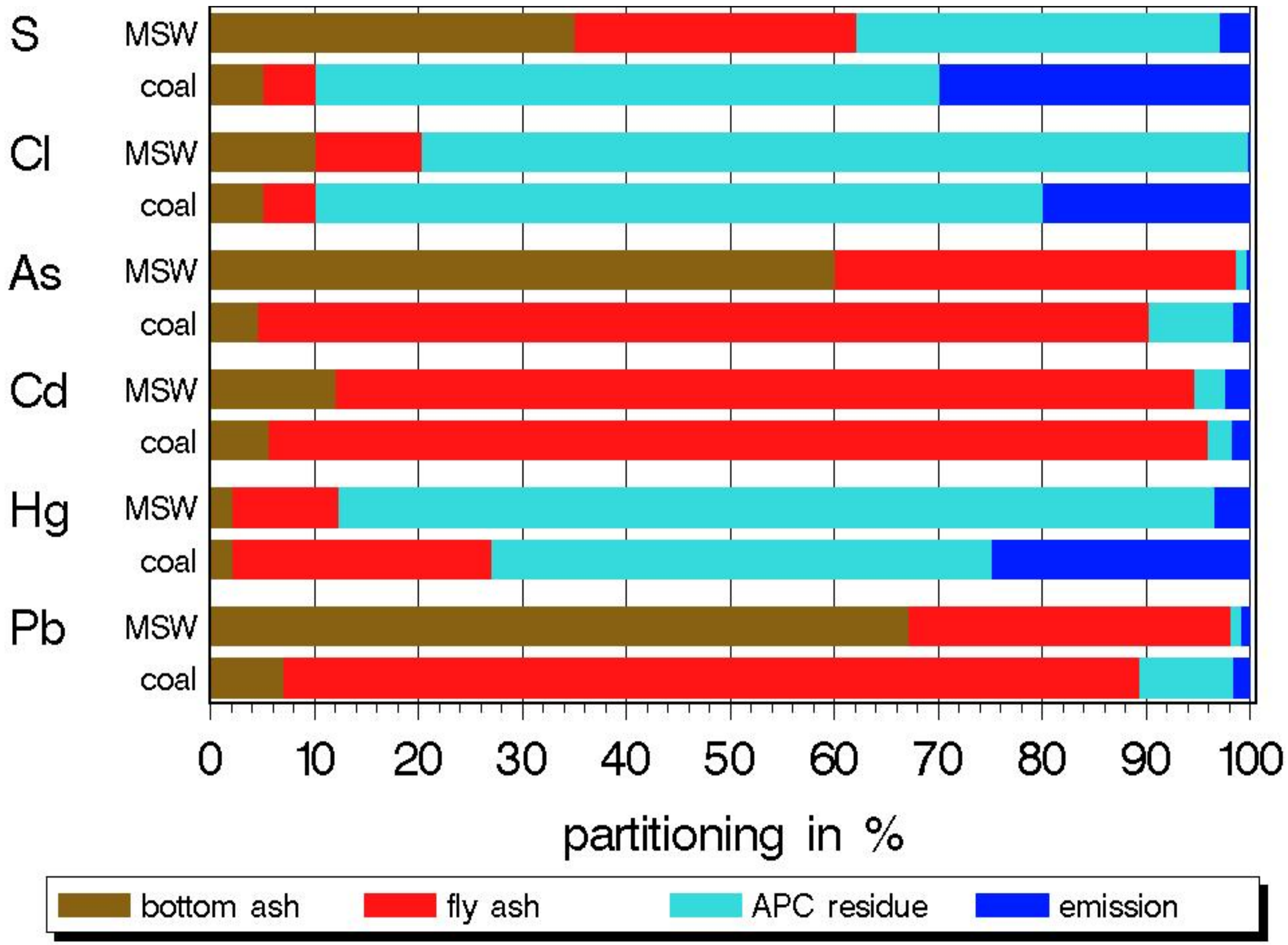


element concentration in MSW and hard coal

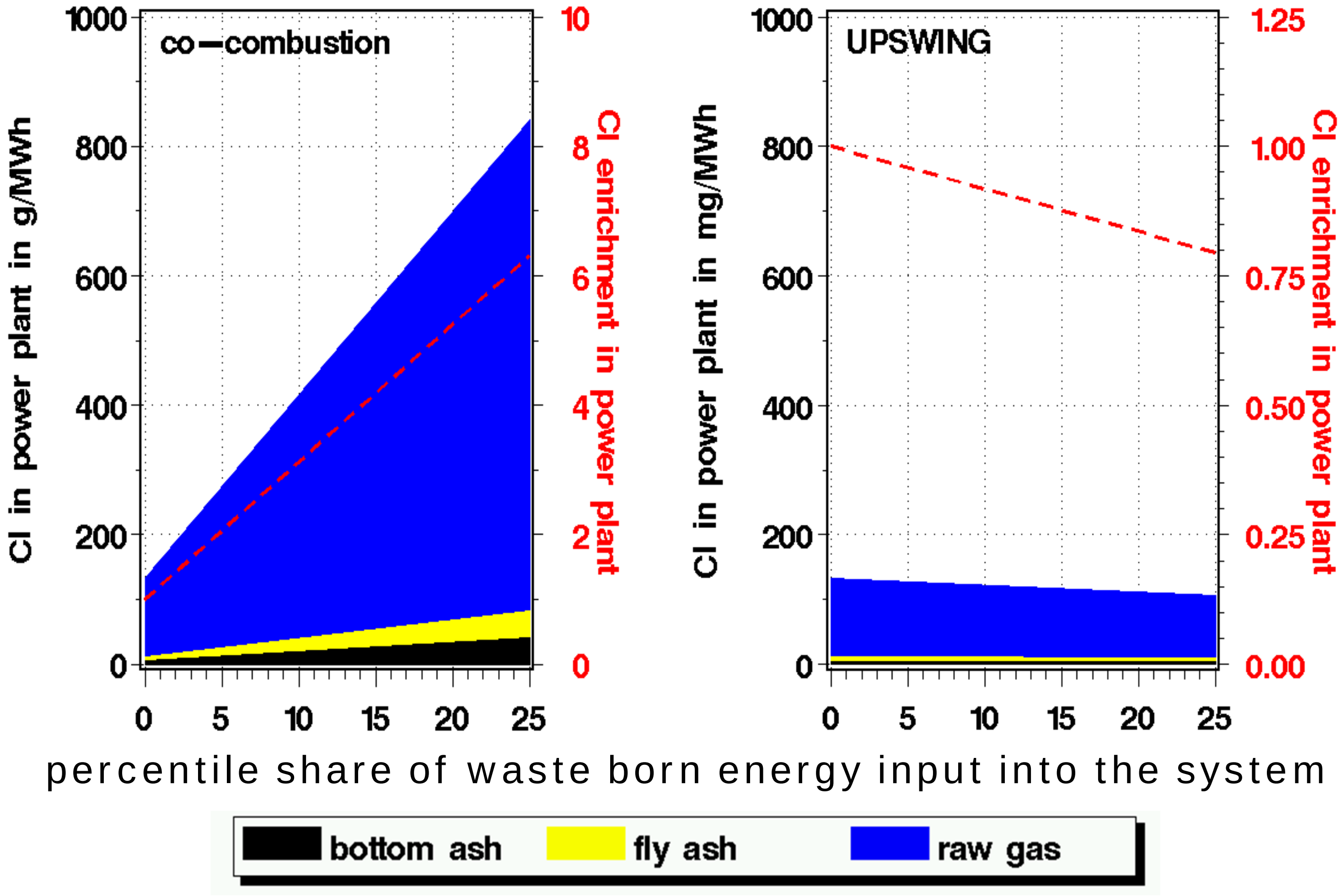
	H_u	V	grate ash	boiler ash	fly ash
	MJ	m^3	kg	kg	kg
MSWI	10	5	0.25	0.003	0.015
coal	30	10	0.0035		0.045

- gas volume ratio PP / MSWI ≈ 10
- energy contribution from waste max. 25 %
- all results standardised to 1 MWh output

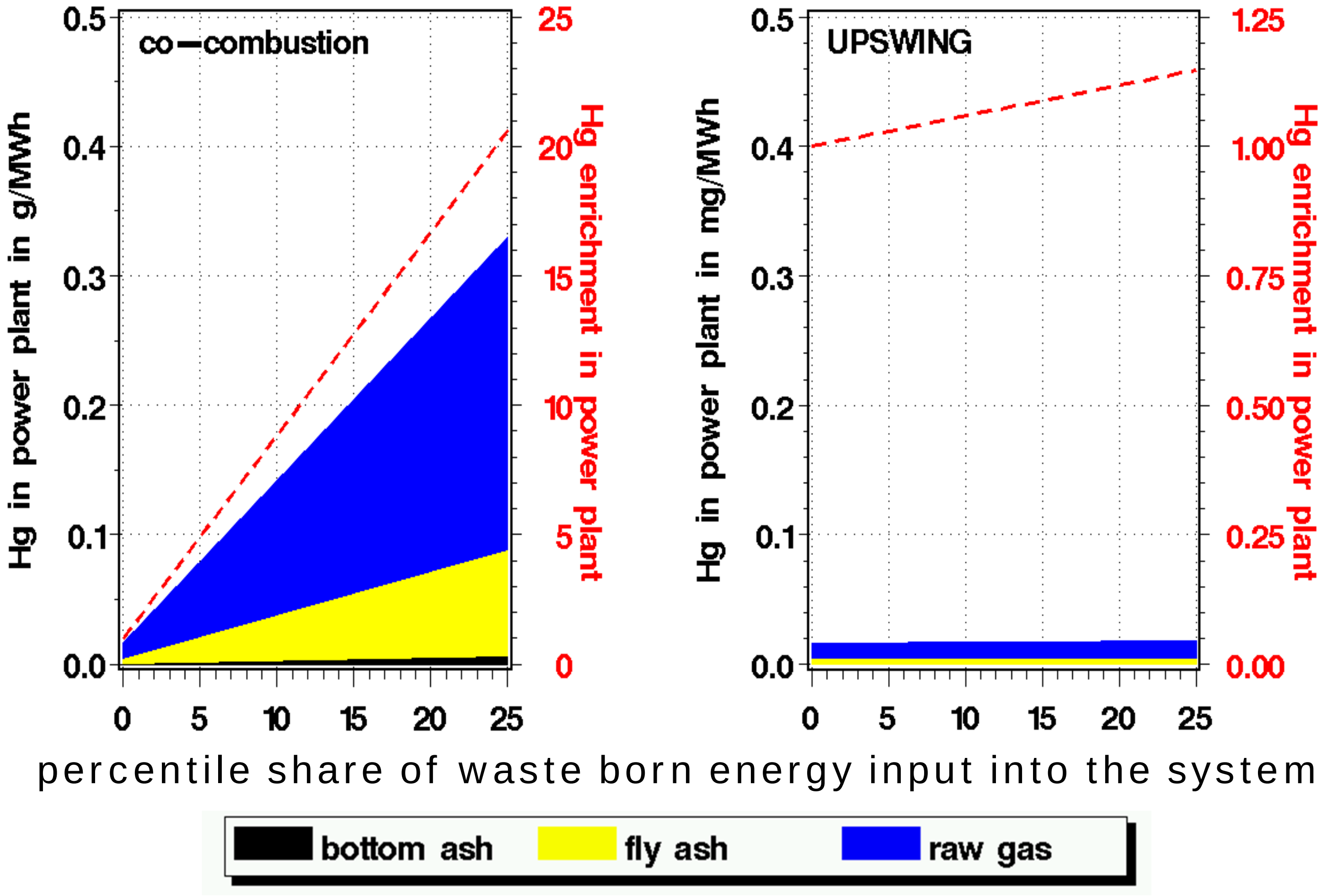
data for calculation of partitioning (per kg fuel)



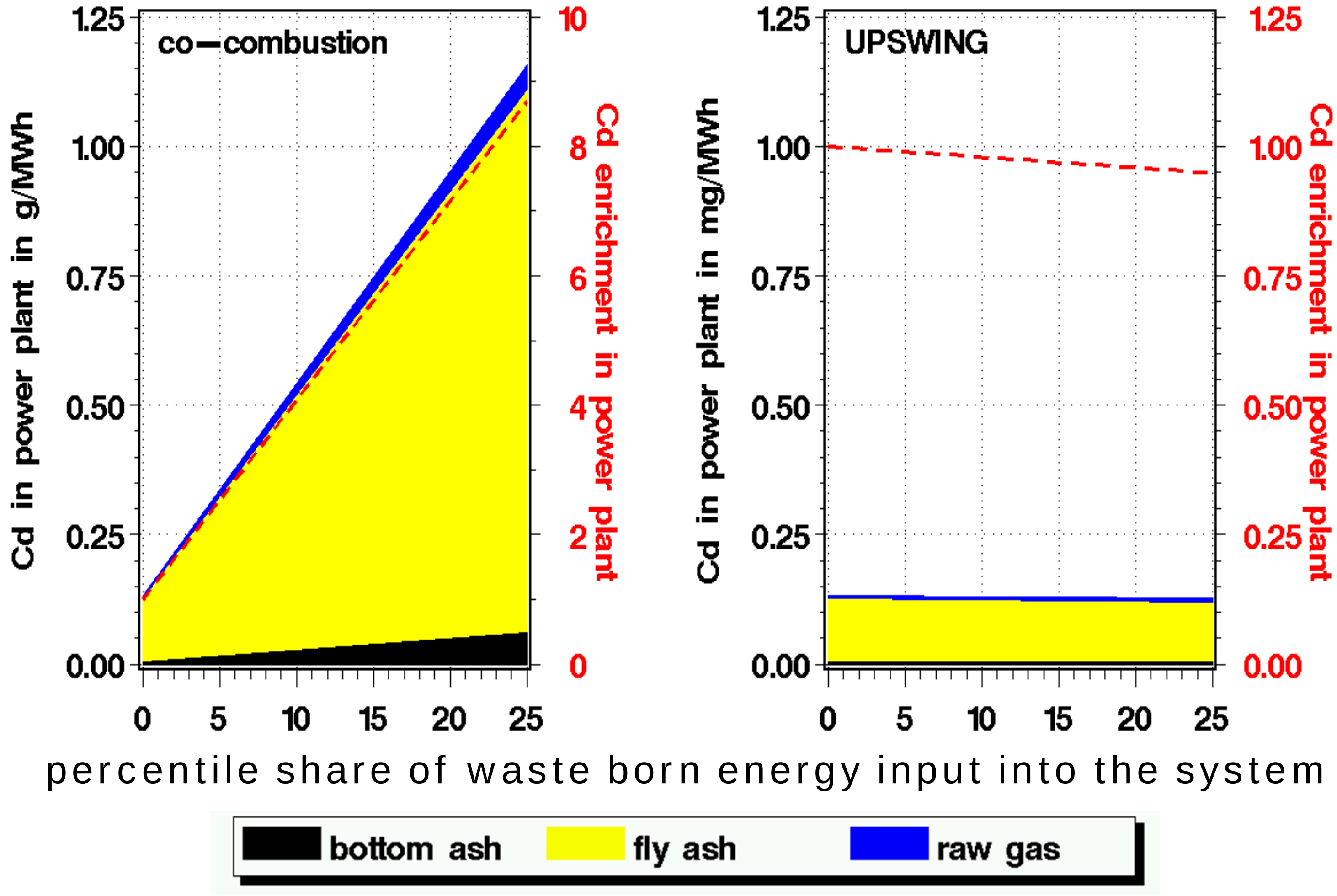
element partitioning in MSWI and CFPP (DBB)



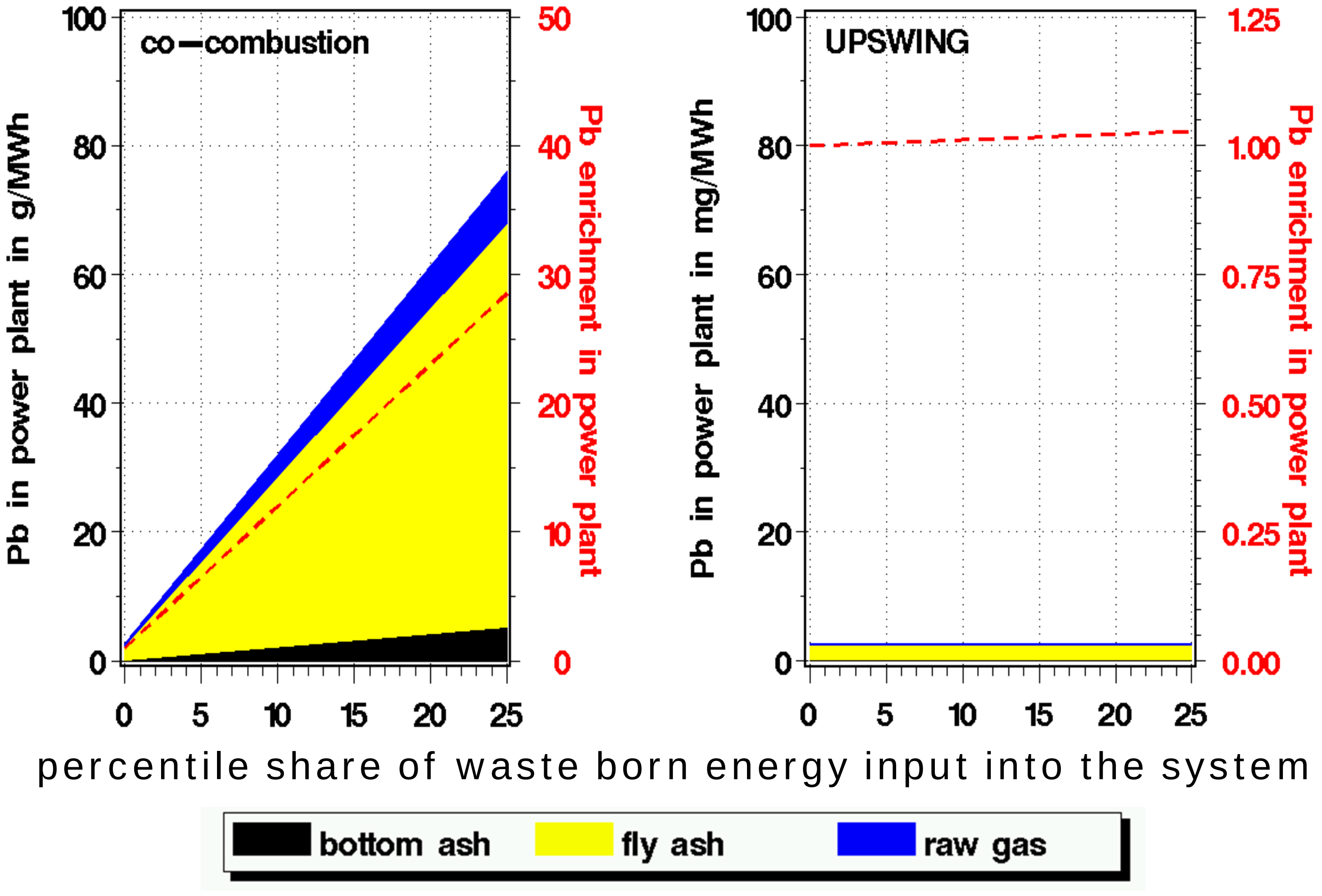
inventory, partitioning, and enrichment of Cl in power plant



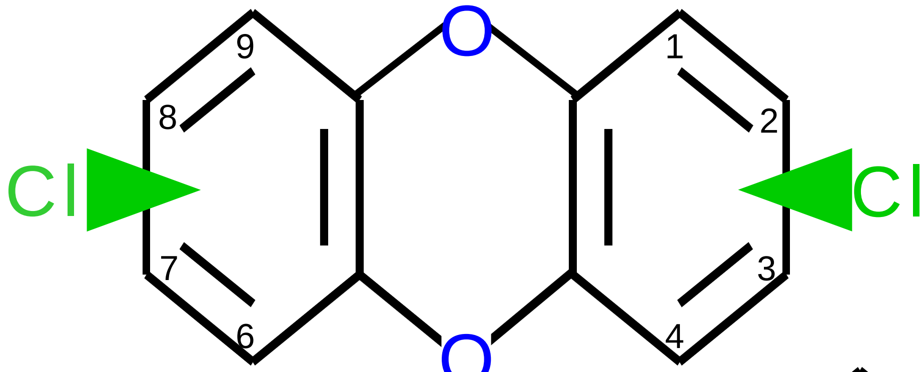
inventory, partitioning, and enrichment of Hg in power plant



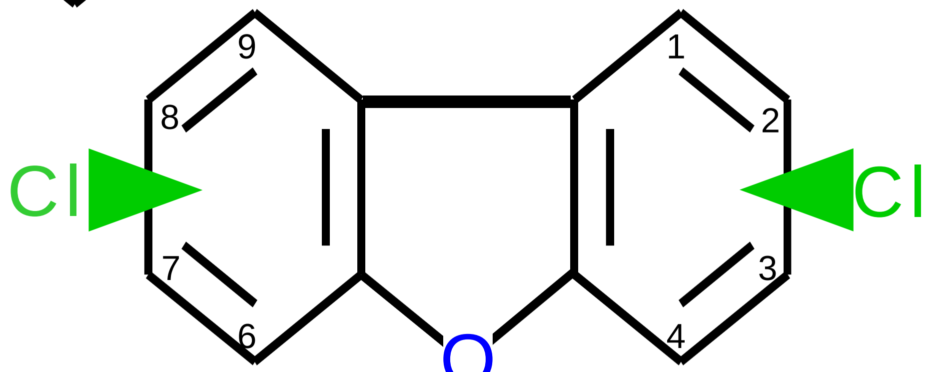
inventory, partitioning, and enrichment of Cd in power plant



inventory, partitioning, and enrichment of Pb in power plant



75 congeners

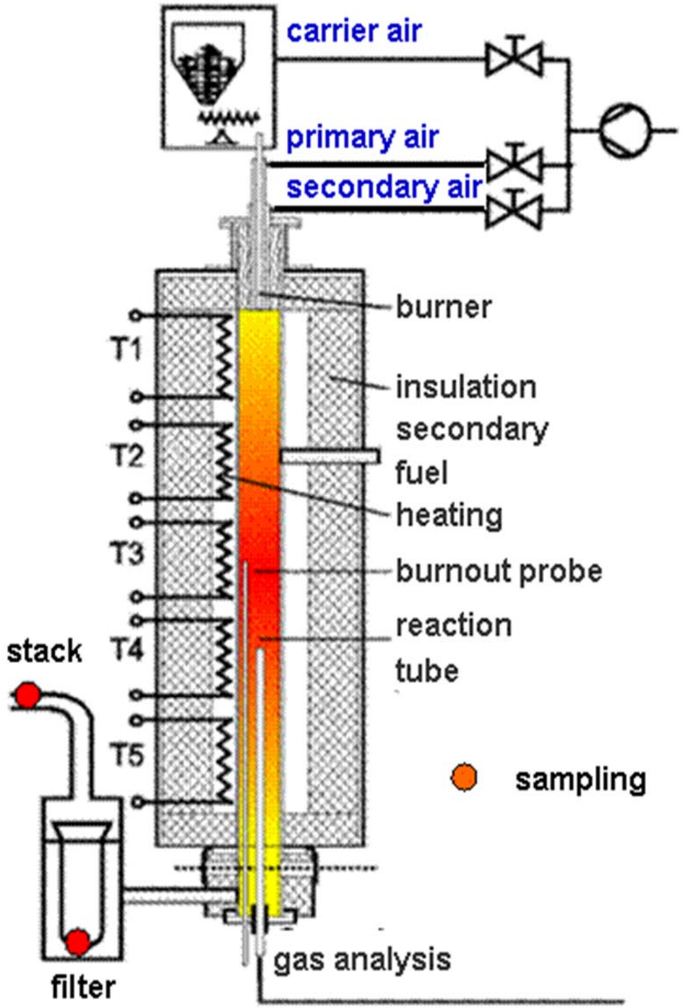


135 congeners

polychlorinated dibenzo-p-dioxins

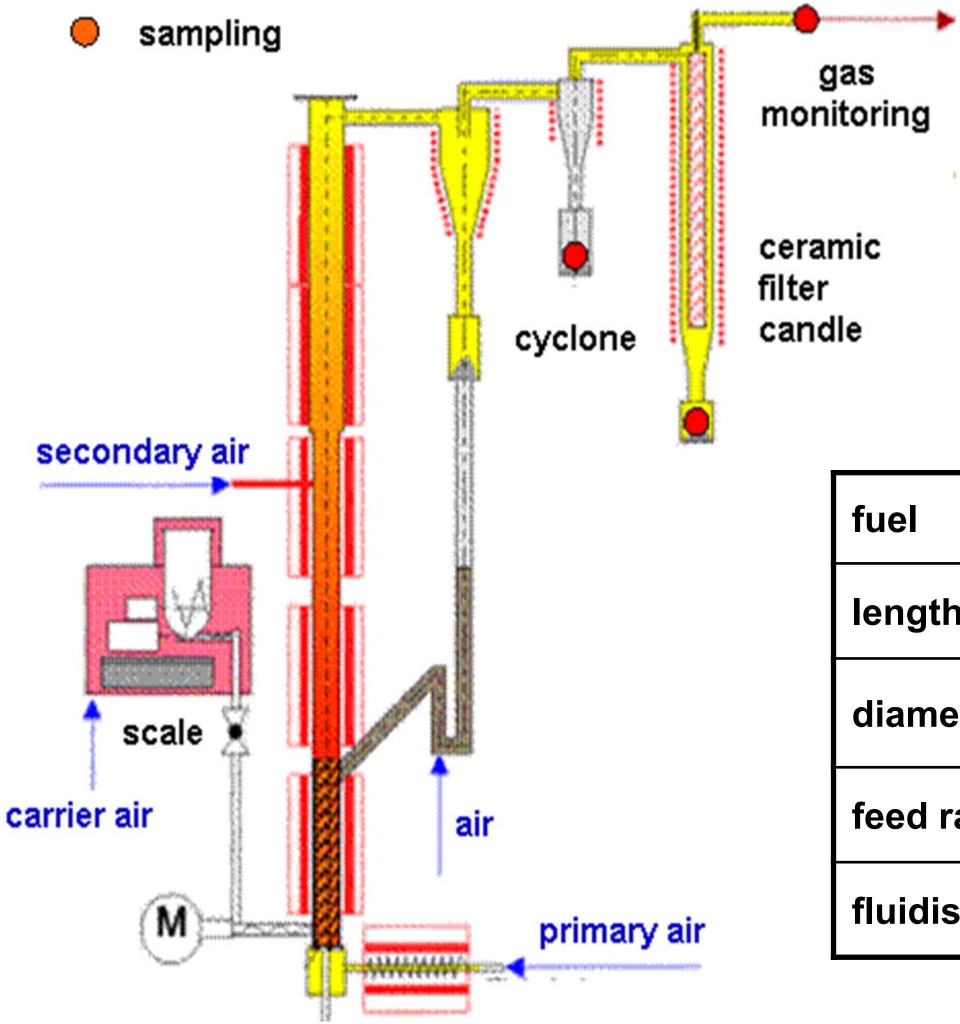
- in waste incineration
  - typical raw gas level approx. 1 ng[TE]/m^3
- in coal fired power plant
  - negligible
  - to clarify: elevated Cl inventory in fuel
- in the UPSWING Process
  - destruction in combustion chamber of power plant

issues concerning PCDD/F



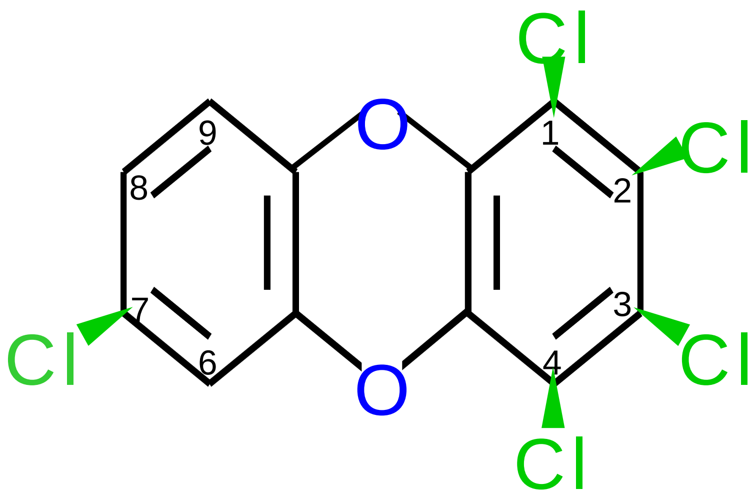
fuel	pulverised coal
length	2500 mm
diameter	200 mm
feed rate	1-5 kg/h
residence time	0.5 - 6 s

scheme of the pulverized coal furnace BTS

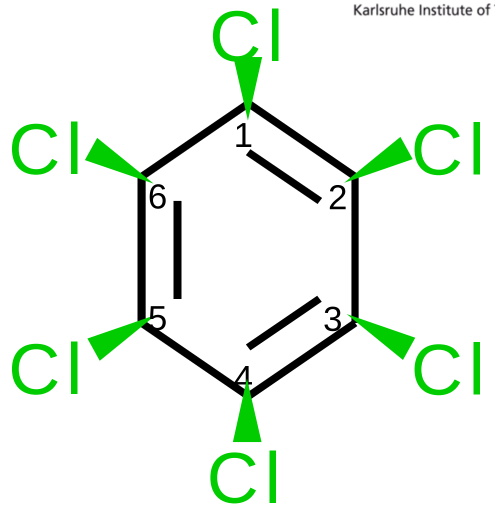


fuel	pulverised coal
length	3250 mm
diameter	furnace 108 mm freeboard 135 mm
feed rate	1-5 kg/h
fluidisation	0.2-1 m/s (bubbling) 1-2 m/s (circulating)

scheme of the fluidised bed furnace ELWIRA



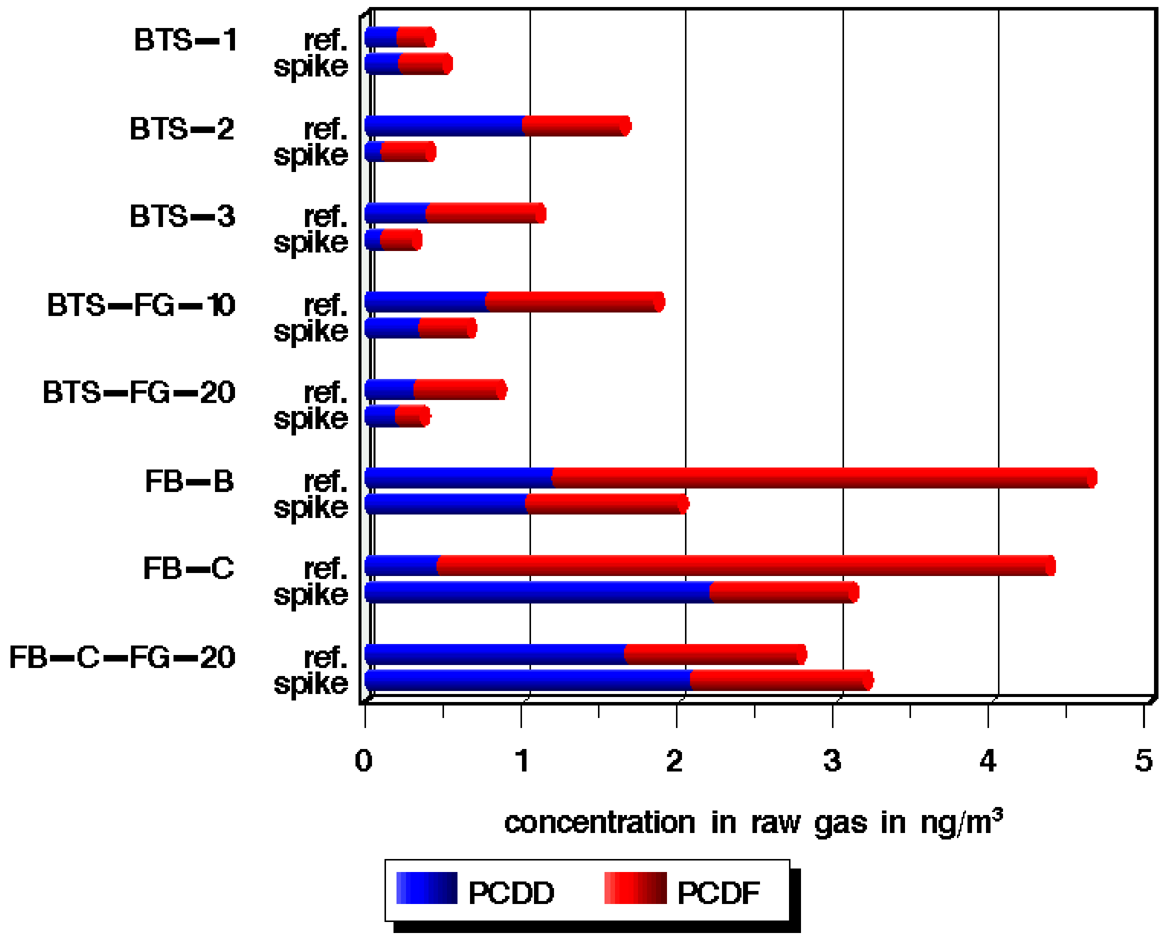
1,2,3,4,7-pentachloro-dibenzo-p-dioxin



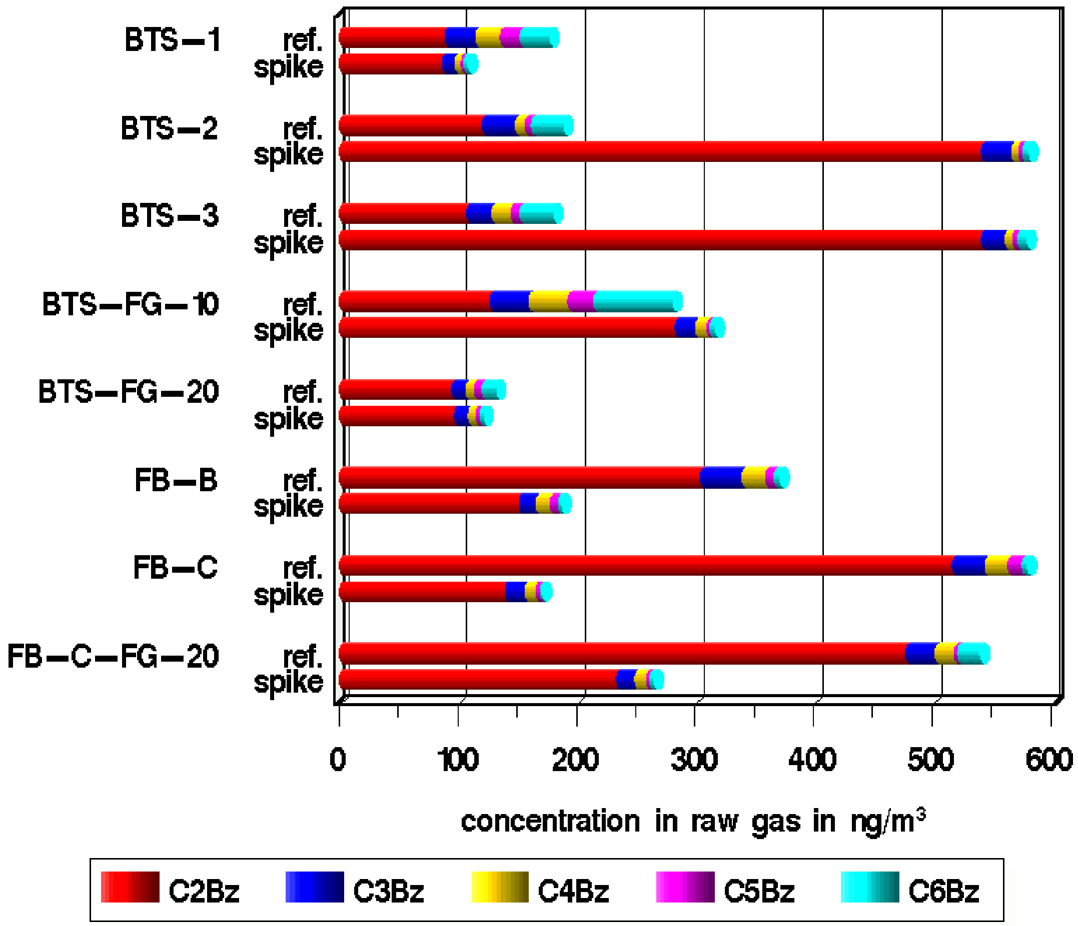
hexachlorobenzene

1200 ng/g	**concentration**	**120 000 ng/g**
9000 ng/m^3	**theoretical raw gas level**	**900 000 ng/m^3**

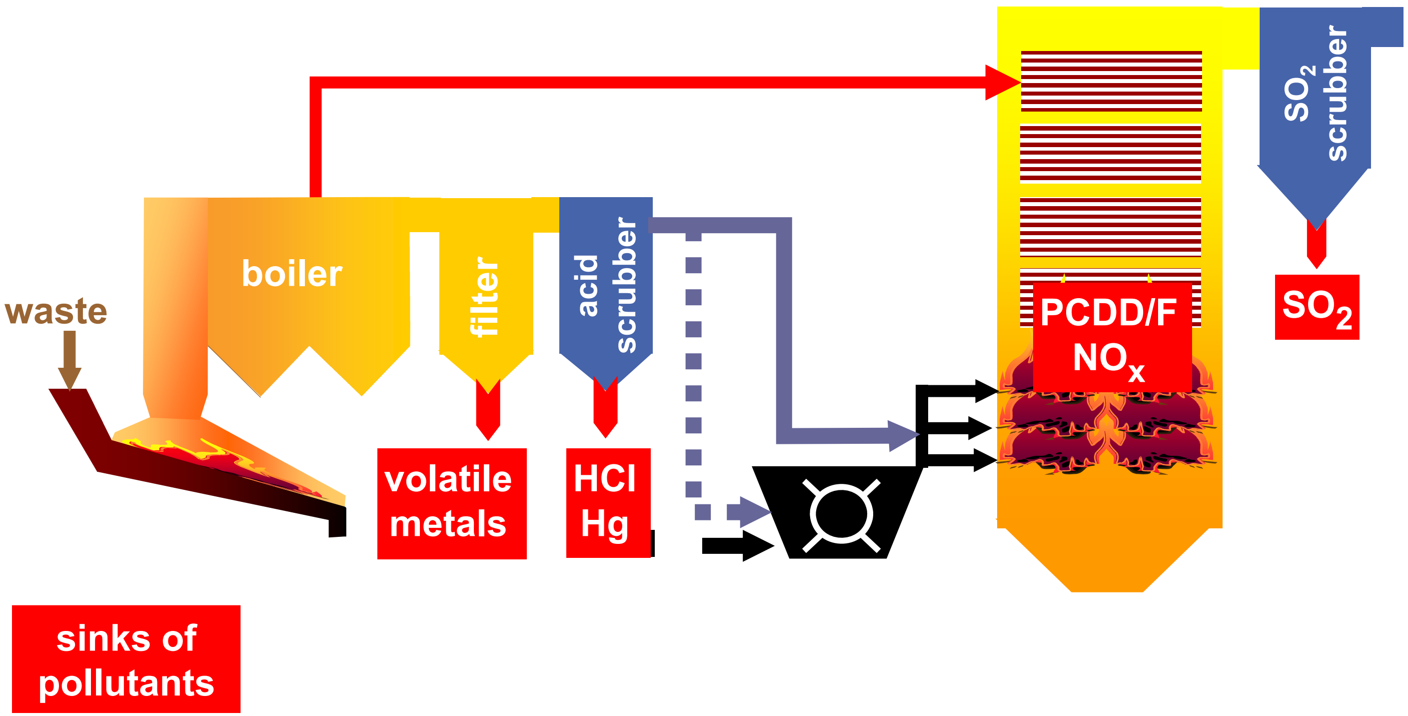
organic spikes on coal



PCDD/F in the raw gas (gas + fly ash)



chlorobenzenes in the raw gas (gas + fly ash)



sink of pollutants in the UPSWING Process

coupling issues

- steam integration
  - best input in cold reheat / feedwater heating circuit
  - steam flow control to cope with emergency shutdowns
- flue gas integration
  - best input close to the bottom ash hopper
  - low MSW flue gas flow (<10 %)
  - no technical problems
  - emergency stack for MSWI
- one MSWI should be coupled to two power plants

economy

- site specific influences
  - prices of coal, heat, and power
  - capital charges, personal cost
  - residue management

- calculation of gate fee for case studies

	Turow (PL)				SUAS (CZ)	
coal price (€/Mg)	15				10.2	
power price (€/MWh)	45				35	
MSW cap. (Mg/a)	150 000		50 000		50 000	
option	MSWI	UPSWING	MSWI	UPSWING	MSWI	UPSWING
gate fee (€/Mg)	42.28	32.25	67.37	66.26	64.85	46.74

conclusions

- technical issues
  - steam and flue gas integration without major problems
  - slight energy efficiency reduction in existing energy optimised power plants
- emission and residues
  - no effect on acid gas emission
  - dioxins destroyed in power plant
  - NO_x emission unchanged
  - metal emissions almost unchanged
  - no alteration of ash quality
- economy
  - looks promising, especially for new installations