

**Large Plants in Lombardy, Italy.  
Authorization, control and emission reduction.**

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## **Subject:**

**various aspects related with pollutant emissions from large combustion plants in the region of Lombardy, in Northern Italy.**

## **Aspects treated:**

- **the authorization process**, ending with a decree with prescriptions
- **typical prescriptions**, emission limit values, general criteria adopted to reduce and control emissions from such plants.
- **checks and controls** by the control authorities.

## Large Plants: definition

For large combustion plants: those defined in EU directive 2001/80/EC of 23 October 2001 (“on the limitation of emissions of certain pollutants into the air from large combustion plants”): the directive applies to combustion plants with a **rated thermal input equal to or greater than 50 MW**, irrespective of the type of fuel used.

Note that Italy has not yet transposed the LCP Directive into national law, (deadline was 27 November 2002) and has therefore received a warning from the EU.

Another type of plant that I will mention is large incinerators (**urban waste and industrial**), which are subject to similar authorization processes and similar types of emission monitoring and controls.

## **THE AUTHORIZATION PROCESS**

### **Combustion Plants**

For authorization purposes, Italian law divides CP's into three categories:

- **Smaller plants ( $P < 50 \text{ MWth}$ )**, only a Provincial authorization.
  
- **Properly defined large combustion plants ( $P \geq 50 \text{ MWth}$ )**, divided into two classes:
  - 1- **rated thermal input  $> 300 \text{ MW}$** , authorization process at a nation level
  - 2- **rated thermal input  $\leq 300 \text{ MWth}$**  with a regional authorization.

In both cases:

**a full Environmental Impact Assessment**, either national or regional, must be submitted before the Operator of a LCP can obtain an authorisation from the appropriate authority (National or Regional, depending on the size of the plant).

the operator needs to obtain an **IPPC authorization**

## **THE AUTHORIZATION PROCESS**

### **Incinerators**

- Urban waste incinerators (UWI)
- Hazardous and non-hazardous waste industrial incinerators

UWI require a regional IPPC authorization if they incinerate > 3 t/h;

hazardous waste > 10 t/day,

non-hazardous waste >50 t/day

In Lombardy: currently 12 UWI's and 45 industrial incinerators.

## **COMPARISON:**

ELV's are usually defined in terms of mass concentration



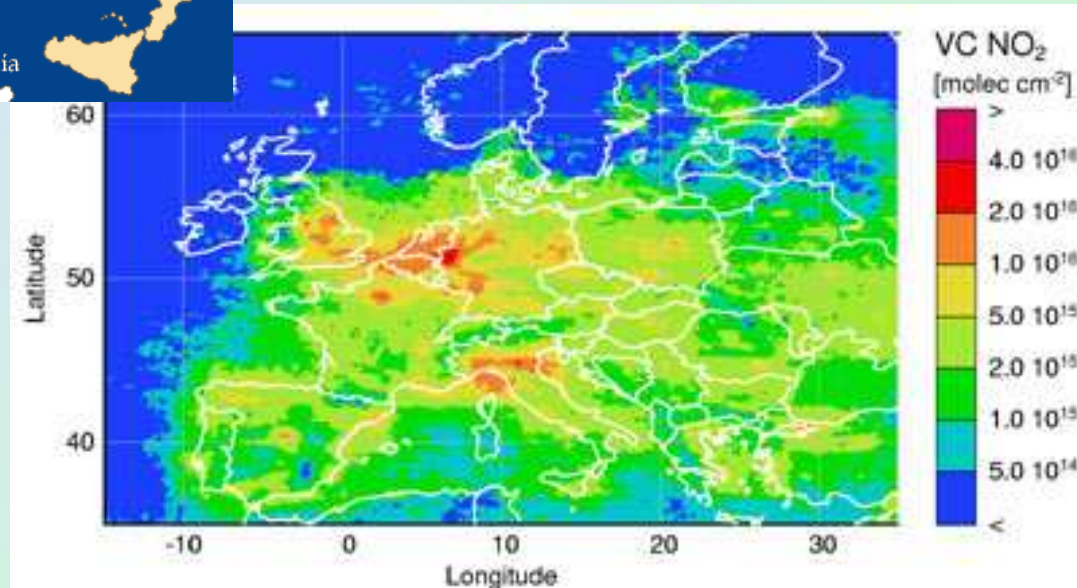
difference in total emissions from different types of plants.

Typically,

**LCP** One 250 MWe group has a  
fumes flow rate of about  $2 \times 10^6$  m<sup>3</sup>/h.

**UWI** A single line (total 3 line, 450000 tons/year)  
fumes flow rate of about  $10^5$  m<sup>3</sup>/h

## Lombardy and air quality



Tropospheric nitrogen dioxide vertical columns over Western Europe as measured by SCIAMACHY on Envisat, averaged between December 2003 and November 2004.

Credits: Institute of Environmental Physics, University of Bremen et al.

## **EMISSION LIMIT VALUES**

### **NATIONAL**

Emission limit values are set in accordance with UE directives.

**Italian law** defines ELV's for large combustion plants in **LAW DECREE 152/2006**.

For incinerators ELV's are defined in **LAW decree 133/2005**, which transposes (with some delay) EU Directive 2000/76/CE into Italian law.

### **REGIONAL**

Each Region may set more restrictive limits (not less restrictive) than the national ones.

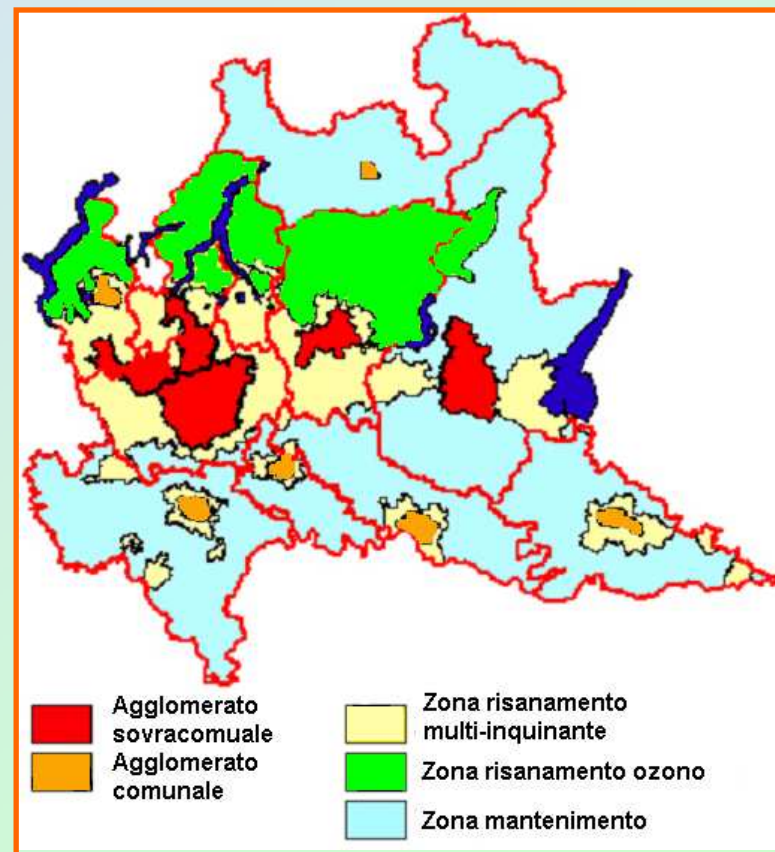
Lombardy, starting with the **Regional Air Quality Plan of 2001** sets more restrictive limits for power plants , depending on the type of fuel used and the area where they operate.

DGR 7/6501 defines agglomerations and zones of the regional territory the as indicated in the framework directive 96/62/CE



## LOMBARDY: agglomerations and zones of the regional territory as indicated in the framework directive 96/62/CE

Zone e agglomerati	Superficie Km2	Residenti
Bergamo	195	298.120
Brescia	398	368.642
Como	236	460.062
Milano	580	2.438.544
Sempione	241	463.315
Cremona	70	72.129
Lecco	45	45.324
Lodi	42	41.990
Mantova	64	49.064
Pavia	63	74.065
Sondrio	21	22.045
Varese	55	84.187
Risanamento multi -inq	5408	2.420.527
Risanamento ozono	7511	557.352
Mantenimento	13520	1.591.433



## **EMISSION LIMIT VALUES**

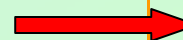
- ELV's set on different pollutants: NO<sub>x</sub>, SO<sub>2</sub>, particulate, CO, PAH, metals, PCDD/PCDF, .... depending on the type of plant.
- Expressed in mg/Nm<sup>3</sup>, assuming an oxygen content by volume in the waste gas of 3 % in the case of liquid and gaseous fuels, 6 % in the case of solid fuels and 15 % in the case of gas turbines

## For NO<sub>x</sub>

For existing plants, limits are set depending on the type of fuel

LARGE COMBUSTION PLANTS				
	Rated thermal input (MWth)	Fuel type	Emission Limit Value NO <sub>x</sub> (mg/Nm <sup>3</sup> ) (Decree 152/2006)	Regional
Existing (before 2006)	50 ≤ P < 500	solid	600	<b>200</b>
	≥ 500	solid	200	
	50 ≤ P < 500	liquid	450	
	P ≥ 500	liquid	200	
	50 ≤ P < 500	gas	300	
	P ≥ 500	gas	200	
New plant	50 ≤ P < 100	solid	400	
	100 ≤ P ≤ 300	solid	200 (300 if biomass)	
	P > 300	solid	200	
	50 ≤ P < 100	liquid	400	
	P ≥ 100	liquid	200	
	50 ≤ P ≤ 300	gas	150	
	P > 300	gas	100	
Gas turbine plant	P ≥ 50 MWth	natural gas	50	<b>30</b>
		different from natural gas	120	

**30**

**For new plants**

Also in Lombardy: mass flow limits for existing plants, where ELV is 50

## EMISSION LIMIT VALUES: EXAMPLE – GAS TURBINE PLANTS

**Number of gas turbine plants increasing**, mostly using natural gas

**Emissions:** mostly NO<sub>x</sub> and CO, but other pollutants as well, since natural gas can contain hydrocarbons and other trace compounds.

**NO<sub>x</sub> reduction technology:** **Low NO<sub>x</sub> burners.**

designed to control fuel and air mixing to reduce peak flame. Reduction in temperature results in less NO<sub>x</sub> formation.

New Dry Low NO<sub>x</sub> systems can reduce NO<sub>x</sub> levels to about **30 mg/Nm<sup>3</sup>**.

**BUT:** **problem of 'real emissions'**.

During cold starts NO<sub>x</sub> can be much higher (up to 1000 mg/Nm<sup>3</sup>). Starts-off can be frequent (operations follow energy demands)

**BUT:** **better energy efficiency** (about 55%, compared to about 35% for older plants)



the emission factors (emissions per energy unit produced) are lower.

## **ELV's: EXAMPLE – URBAN WASTE INCINERATORS**

**New IPPC authorizations** set limit values of **60 mg/Nm<sup>3</sup>** for the annual average and **80** for the hourly limit.

This requires the **introduction of new technologies**

The emission reduction technology can itself be the cause of the presence of other pollutants: use of urea or ammonia for **SNCR**-based NO<sub>x</sub> control (**120-150 mg/Nm<sup>3</sup>**) (Selective **NON** Catalytic Reduction) can cause ammonia to be present in the emissions, which can produce ammonium salts (particulate).

**Typical NO<sub>x</sub> reduction technologies are:**

- water-steam injection: now rather obsolete, since it does not allow to reduce NO<sub>x</sub> concentration under about 100 mg/Nm<sup>3</sup>
- SCR systems are very efficient at reducing NO<sub>x</sub> (possible to reach 60-80 mg/Nm<sup>3</sup>) but have the problem of ammonia emissions.

The ARPA (Regional Environmental Agency) is the control authority.

**Requirements for both LCP's and WI's**

- **Initial communications by the operator** (plant start-up, first check on emissions)
- Next, **ARPA performs administrative compliance and technical controls.** Off-line measurements for micro-pollutants, metals, PAH to verify respect of ELV's.
- **Automated Measuring Systems** (the new European term for CEMS (continuous emissions monitoring system)).

In Italy controls on AMS are prescribed by D. LgsI 152/2006 (LCP's) and D. LgsI. 133/2005 (Incinerators) and are based on EN 14181 standard (Stationary source emissions -quality assurance of automated measuring systems), not yet transposed into national law.

In Italy **AMS controls based on relative accuracy test** (from ASTM STP 598 standard for gaseous pollutants)

**In Lombardy, additional provisions on the criteria and procedures for the operation of a continuous emissions monitoring system installed in a waste incinerator:**

- Minimal requirements on zero and span drift, valid available data, maintenance of the system, operation log, ...

- The control authority (ARPA) collaborates with the Regional authorities to emit **procedures** indicating more detailed requirements for each type of plant.
- One procedure developed by ARPA is a **management manual** for CEMS, that operators are requested to introduce. ARPA then works with the operator to adapt the manual to the specific plant.
- One important aspect of the manual is the requirement of **communications** from operators to control and authorising authorities, that must be timely informed of any malfunction, abnormal operating condition or limit exceedance.

**Case of an Urban Waste Incinerator in Milano:**

**Protocol** agreed upon with participation of local authorities (4 City administrations, Province, Region, operator, ARPA).

**Prescriptions on emission reduction over time,**

**waste-to-energy facility** uses energy produced for district heating, thereby reducing area emissions.

**Ambient monitoring.**



## **Agreement protocol of 2004 - UWI**

### **Lombardy Region, Province of Milano, Cities, Operator, Electric Company**

#### **1- Further reduction of emissions** (detailed timetable)

- ✓ Catalytic DeNO<sub>x</sub> on all three lines
- ✓ Installation on the three line of new HCl reduction system

#### **2- District heating**

- ✓ The plant would provide 112 MWth for district heating of new areas
- ✓ Electric company will lower costs for the cities, thanks to reduced costs by waste-to-energy plant

## Agreement protocol 2004

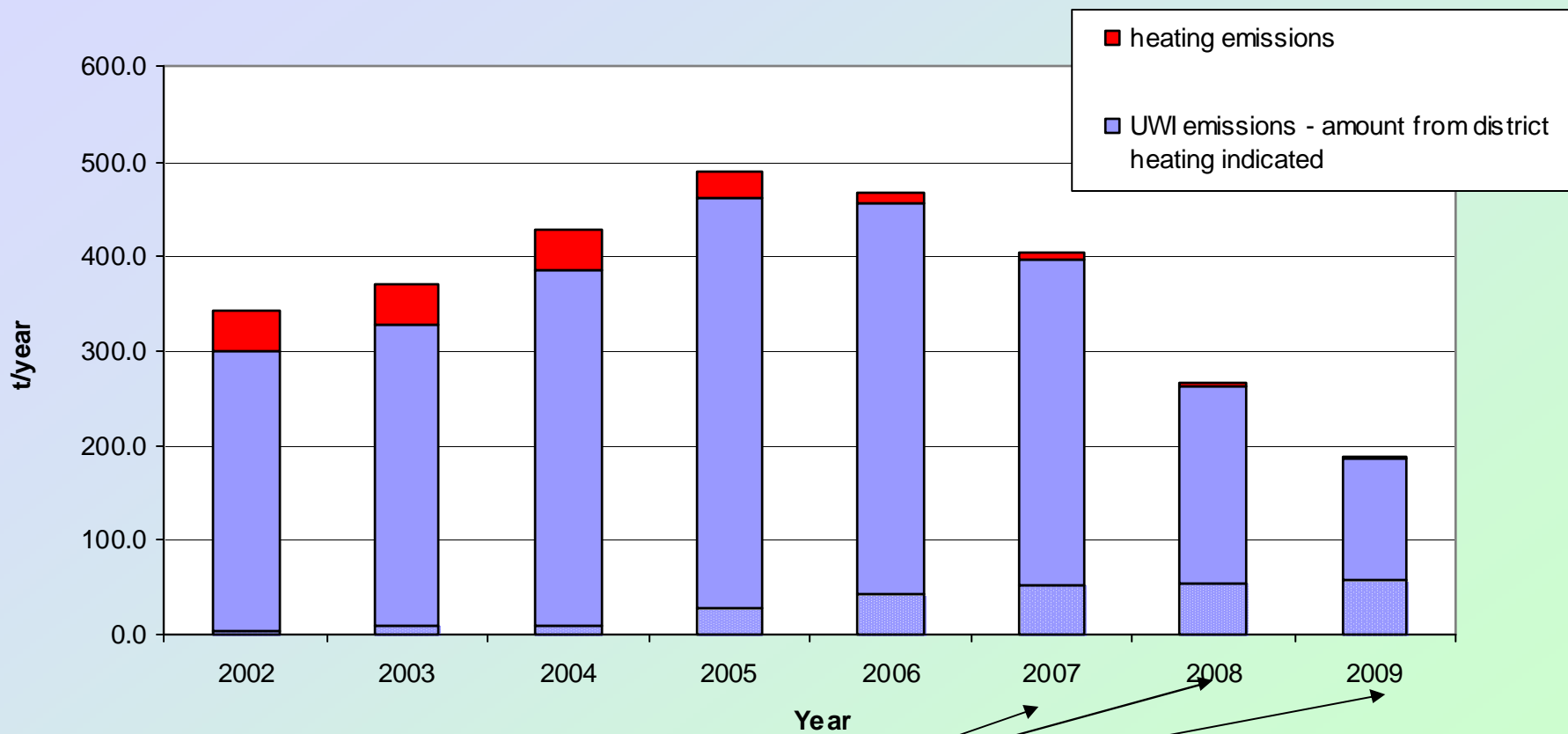
3- Technical-scientific committee with experts nominated by the cities

4- Plant must obtain EMAS certificate

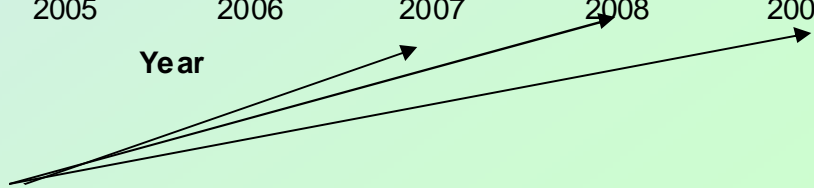
### 5- Environmental monitoring in the area

- ✓ Project by ARPA, paid for by plant operator
- ✓ Emission monitoring: continuous PCCD/PCDF sampling system. Continuous monitoring data and plant malfunctionings and exceedances to be communicated according to a protocol agreed upon with ARPA.
- ✓ Estimate of Valutazione del potere calorifico inferiore (PCI) medio, per controllare che il rifiuto avviato alla combustione abbia un PCI medio maggiore di 2600 Kcal/Kg su base annua. Metodo di valutazione da concordare con ARPA.

### Total emissions: area budget



Catalytic DeNOx installation



## Measured emissions - Incinerator

<b>Pollutant</b>	<b>Emissions</b>	<b>Emission factor</b>
	<b>(concentration: mg/Nm<sup>3</sup>)</b>	<b>(g/t)</b>
NO <sub>x</sub>	140	987
NH <sub>3</sub>	4	28
HCl	7	48
CO	8	56
SO <sub>2</sub>	2	11
VOC's	< 1	2
Particulate	< 0.3	2.7

## Estimated emissions – Incinerator

Pollutant	30 min ELV	30 min ELV	Mass concentration mg/Nm3 (estimate)	Pollutant mass emitted per year (t/yr)			
	National (mg/Nm3)	regional (mg/Nm3)		2005	2007	2008	2009
HCl	60		7.5	21.542625	17.6	8.1	5.7
CO			6	17.2341			
NOx	400	200	140	402.129	344.7	215.4	143.6
NH3	-	30	4	11.4894			
SO2	200		2.5	7.180875			
COT	20		0.3	0.861705			
PTS	30		0.3	0.861705			
<b>Metal compounds</b>			0.002	0.0057447			
Hg		0.05					
Cd	and its compounds	0.05					
Tallio	and its compounds						
Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V	and its compounds	0.5					
IPA			0.00005	0.000143618			
PCB			0.0000009	2.58512E-06			
PCDD+PCDF			0.00000002	5.7447E-08			

at 450000 t/year of incinerated waste