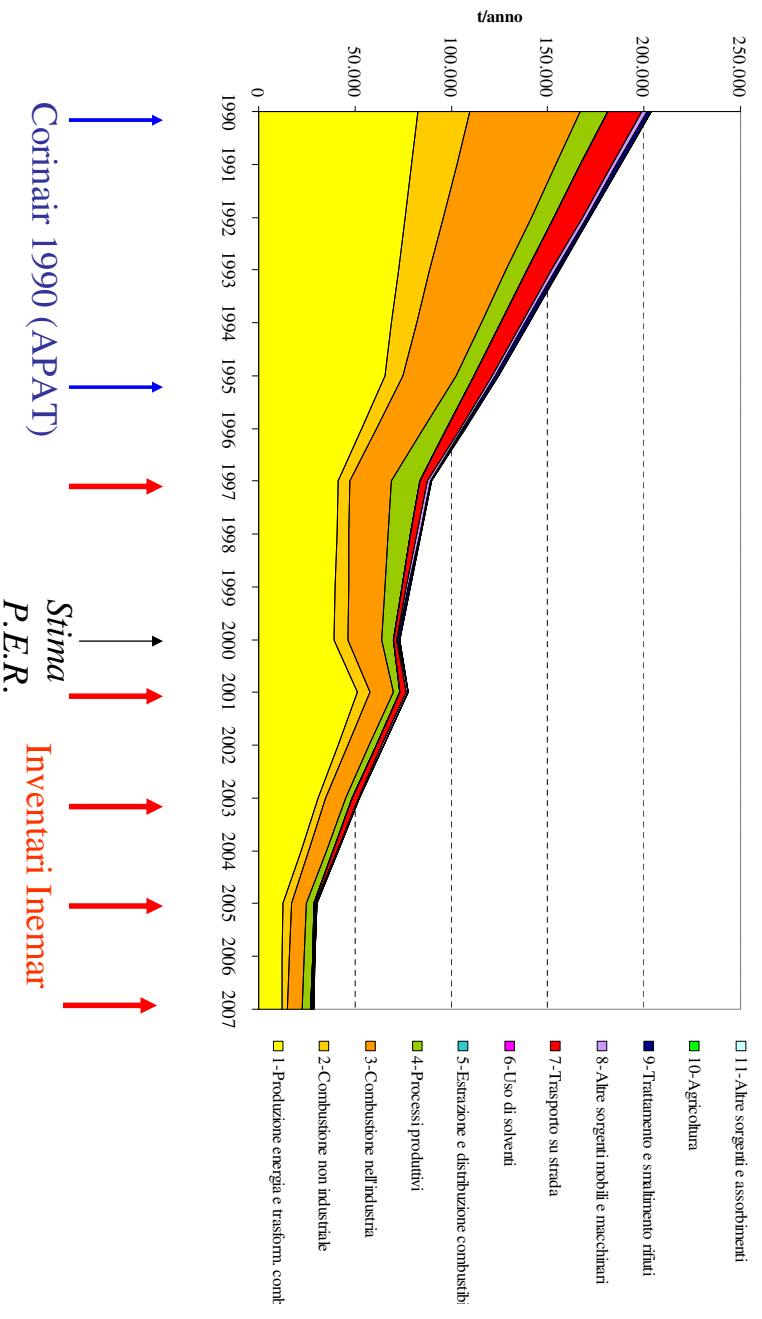


Trend nelle emissioni e necessità di approfondimenti

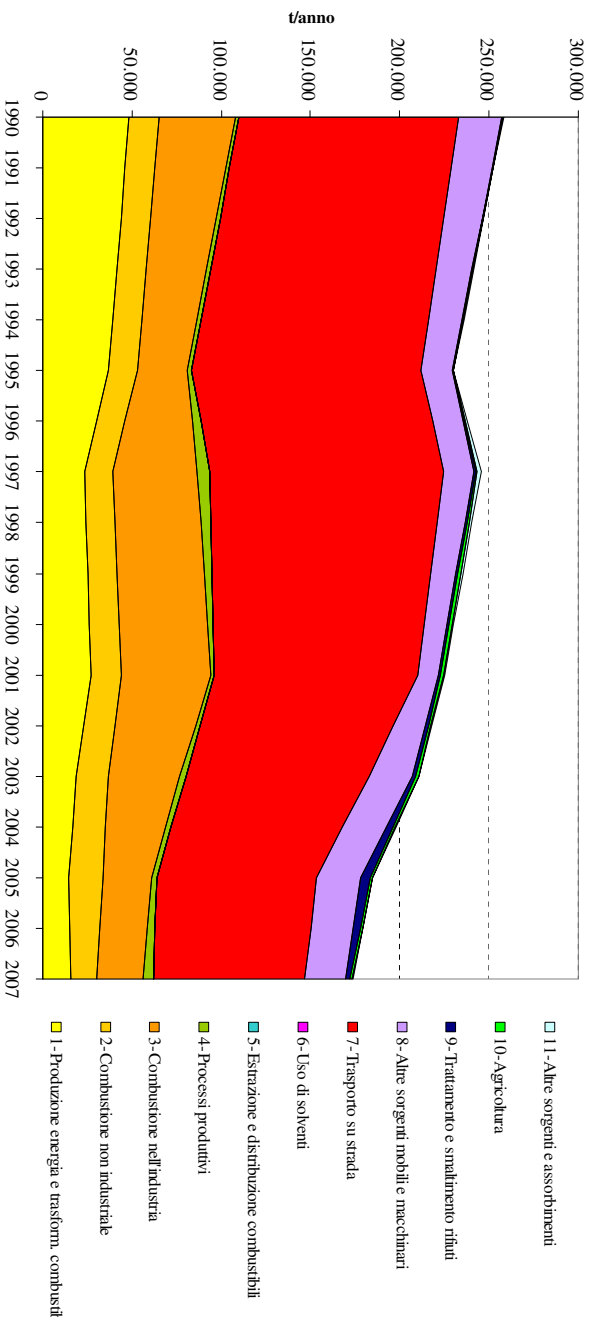
Ing. Stefano Caserini

22 febbraio 2010

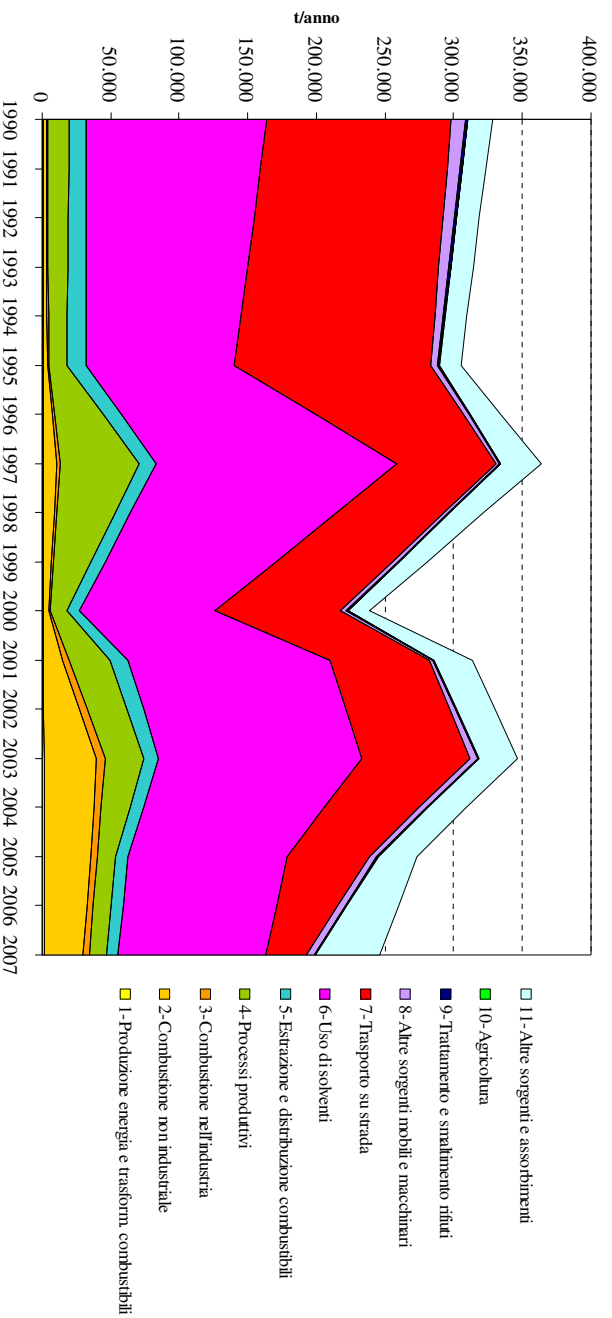
Andamento delle emissioni 1990 - 2007: SO₂



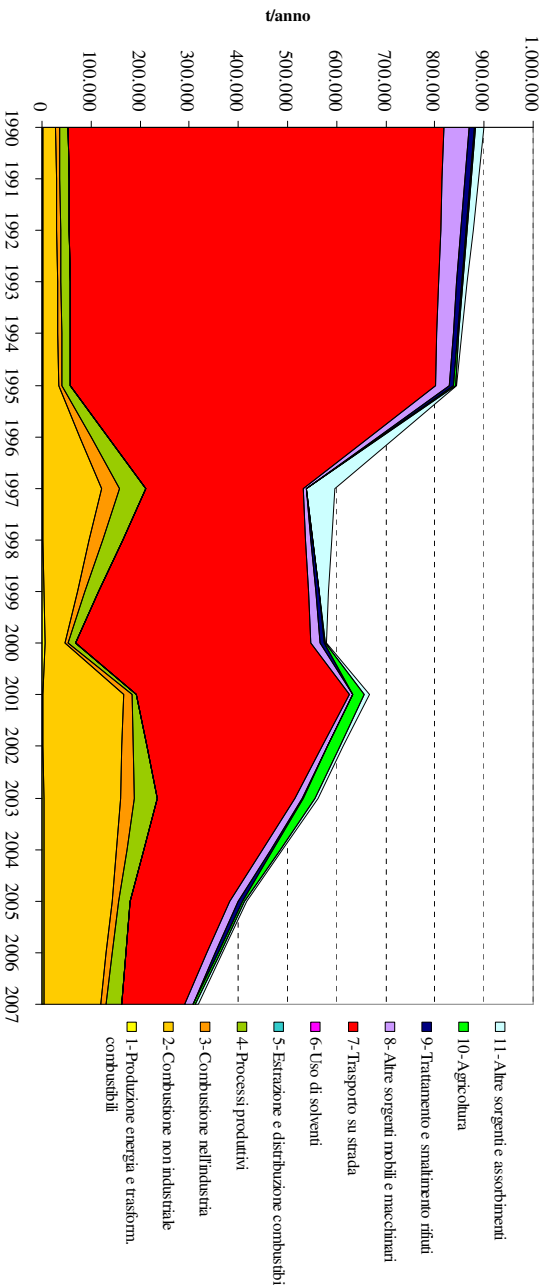
Andamento delle emissioni 1990 - 2007: NO_x



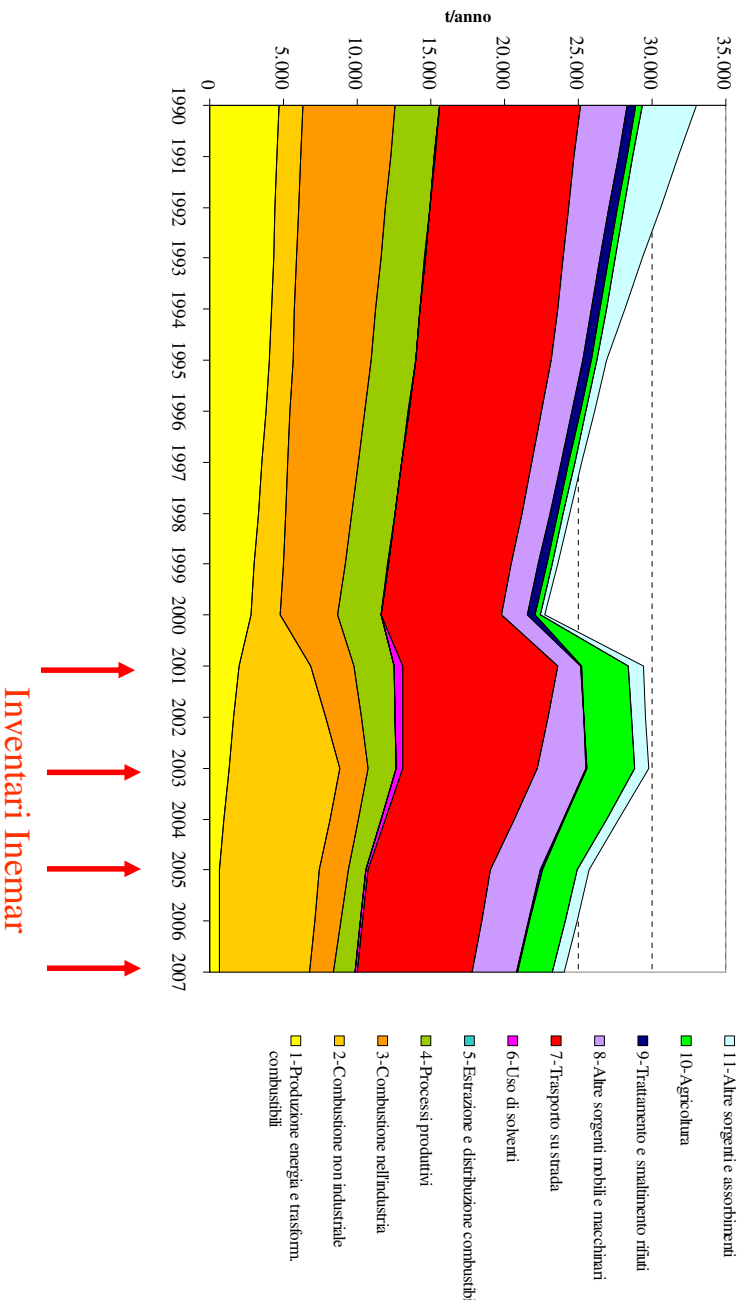
Andamento delle emissioni 1990 - 2007: COV



Andamento delle emissioni 1990 - 2007: CO



Andamento delle emissioni 1990 - 2007: PTS



Emissioni di CO₂eq in Lombardia dal 1990 al 2007

ripartite per macrosettore

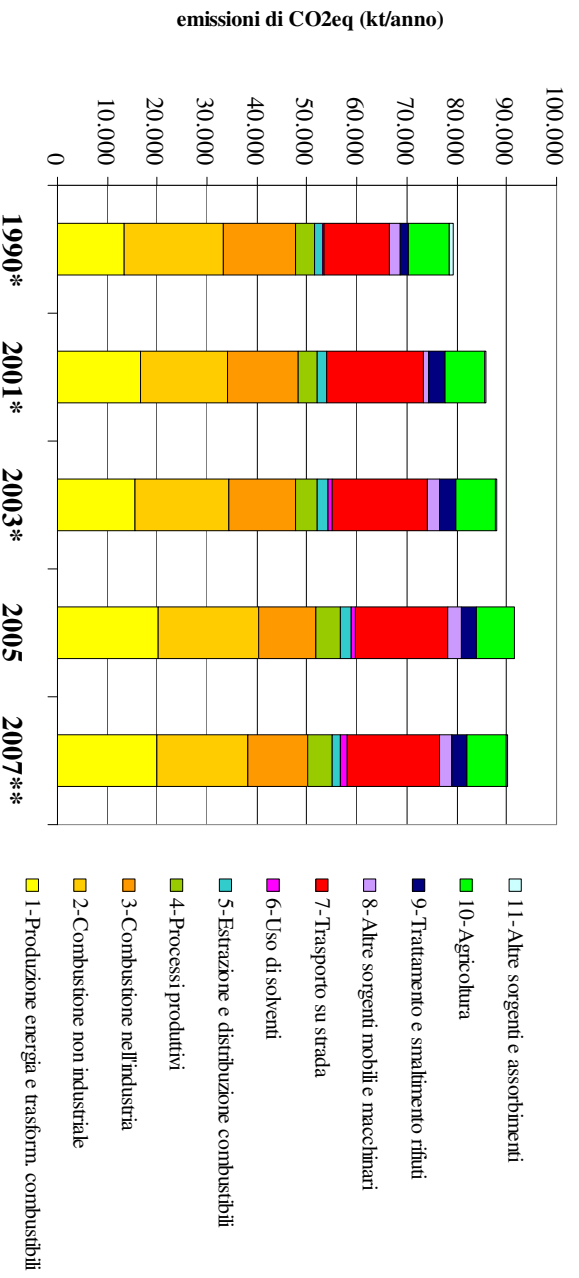
CO ₂ eq	1990*	2001*	2003*	2005	2007**
	kt/anno	kt/anno	kt/anno	kt/anno	kt/anno
1-Produzione energia e trasform. combustibili	13.428	16.513	15.542	20.282	20.009
2-Combustione non industriale	19.848	17.603	18.810	20.170	18.204
3-Combustione nell'industria	14.371	14.189	13.422	11.367	11.925
4-Processi produttivi	3.739	3.709	4.243	4.779	4.832
5-Estrazione e distribuzione combustibili	1.677	1.935	2.165	2.176	1.834
6-Usi di solventi	411		966	1.031	1.106
7-Trasporto su strada	13.048	19.398	18.883	18.508	18.575
8-Altre sorgenti mobili e macchinari	2.217	1.086	2.428	2.555	2.427
9-Trattamento e smaltimento rifiuti	1.487	3.314	3.467	2.974	3.207
10-Agricoltura	8.381	7.850	7.895	7.660	7.885
11-Altre sorgenti e assorbimenti	795	101	105	102	105
Totale	79.402	85.697	87.927	91.603	90.109

* senza contributo degli F-gas

** dati non definitivi, per la revisione pubblica

Emissioni di CO₂eq in Lombardia dal 1990 al 2007

ripartite per macrosettore



Distribuzione percentuale delle emissioni di CO₂eq in Lombardia dal 1990 al 2007 per macrosettore

	1990*	2001*	2003*	2005	2007*
1-Produzione energia e trasform. combustibili	17 %	19 %	18 %	22 %	22 %
2-Combustione non industriale	25 %	21 %	21 %	22 %	20 %
3-Combustione nell'industria	18 %	17 %	15 %	12 %	13 %
4-Processi produttivi	5 %	4 %	5 %	5 %	5 %
5-Estrazione e distribuzione combustibili	2 %	2 %	2 %	2 %	2 %
6-Uso di solventi	1 %	0 %	1 %	1 %	1 %
7-Trasporto su strada	16 %	23 %	21 %	20 %	21 %
8-Altre sorgenti mobili e macchinari	3 %	1 %	3 %	3 %	3 %
9-Trattamento e smaltimento rifiuti	2 %	4 %	4 %	3 %	4 %
10-Agricoltura	11 %	9 %	9 %	8 %	9 %
11-Altre sorgenti e assorbimenti	1 %	0 %	0 %	0 %	0 %
Totale	100 %	100 %	100 %	100 %	100 %

* senza contributo degli F-gas
 ** dati non definitivi, per la revisione pubblica

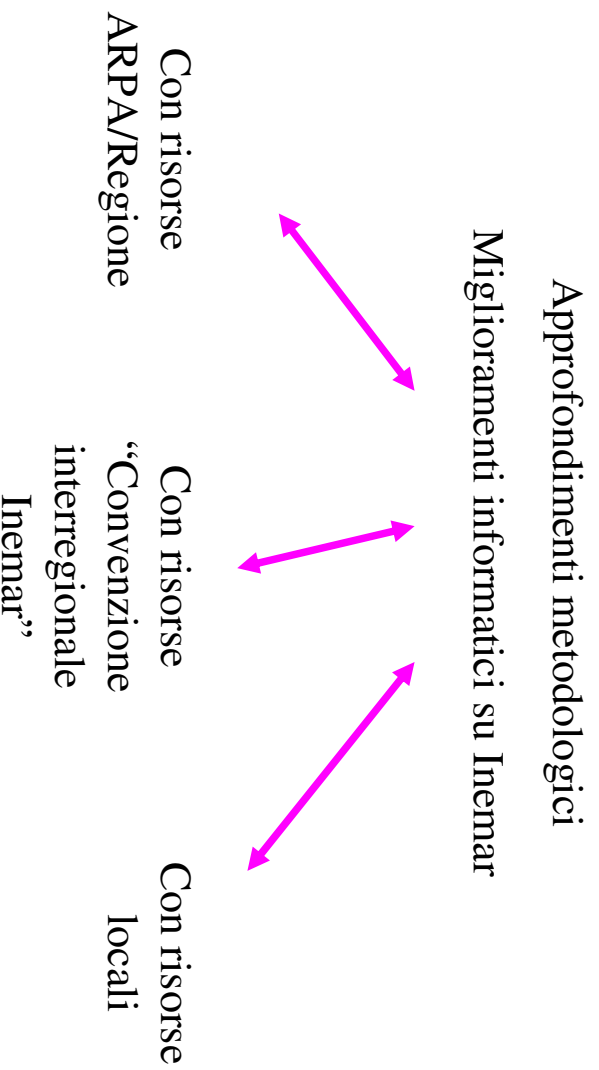
Variazione percentuale delle emissioni di CO₂eq in Lombardia dal 1990 al 2007 per macrosettore

	1990 - 2001	2001-2003	2003-2005	2005-2007	1990-2007
	%	%	%	%	%
1-Produzione energia e trasform. combustibili	23 %	-5,9 %	30 %	-1,3 %	49 %
2-Combustione non industriale	-11 %	6,9 %	7,2 %	-9,7 %	-8,3 %
3-Combustione nell'industria	-1,3 %	-5,4 %	-15 %	4,9 %	-17 %
4-Processi produttivi	-0,8 %	14 %	13 %	1,1 %	29 %
5-Estrazione e distribuzione combustibili	15 %	12 %	0,5 %	-16 %	9,4 %
6-Uso di solventi	49 %	-2,7 %	6,8 %	7,2 %	169 %
7-Trasporto su strada	-51 %	124 %	-2,0 %	0,4 %	42 %
8-Altre sorgenti mobili e macchinari	123 %	4,6 %	-14 %	7,8 %	9,4 %
9-Trattamento e smaltimento rifiuti	-6,3 %	0,6 %	-3,0 %	2,9 %	-5,9 %
10-Agricoltura	-87 %	4,2 %	-3,2 %	3,7 %	-87 %
11-Altre sorgenti e assorbimenti	7,9 %	2,6 %	4,2 %	-1,6 %	13 %
Totale	7,9 %	2,6 %	4,2 %	-1,6 %	13 %

Attività in corso

- Versione definitiva inventario 2007 /aggiornamento a 2008 (entro settembre 2010)
- Correzioni (es. errori di attribuzione attività SNAP)
- Affinamenti (nuovi dati puntuali, nuovi F.E., ecc)
- Aggiunte (es. impianti puntuali ?)
- Aggiornamenti (es. artemis, Copert nuovi FE mezzi pesanti)

Attività in corso / future già previste



Possibili ulteriori approfondimenti

- Ruolo centrale delle emissioni dalla combustione della legna, sia per le emissioni attuali che per gli scenari di emissione: ruolo chiave per l'affinamento delle stime di PM, COV e composti tossici a livello locale
- Aggiornamento periodico consumi di legna da ardere
- Approfondimenti su Off-road (indicatori e FE)
- Approfondimenti sulle percorrenze dei veicoli passeggeri e merci
- Approfondimenti su emissioni di COV
- Emissioni dalla combustione delle paglie di riso e biomasse del settore agricoltura
- Indagine sul consumo di combustibili e carburanti nelle attività agricole (trattori - riscaldamento serre - essiccatoi)
- Emissioni di “soot” (fuliggine)

WOOD COMBUSTION Lombardy region

In all the municipalities in the plain (altitude < 300 meters) in Lombardy region, from winter 2006/2007 wood combustion has been prohibited in all the appliances:

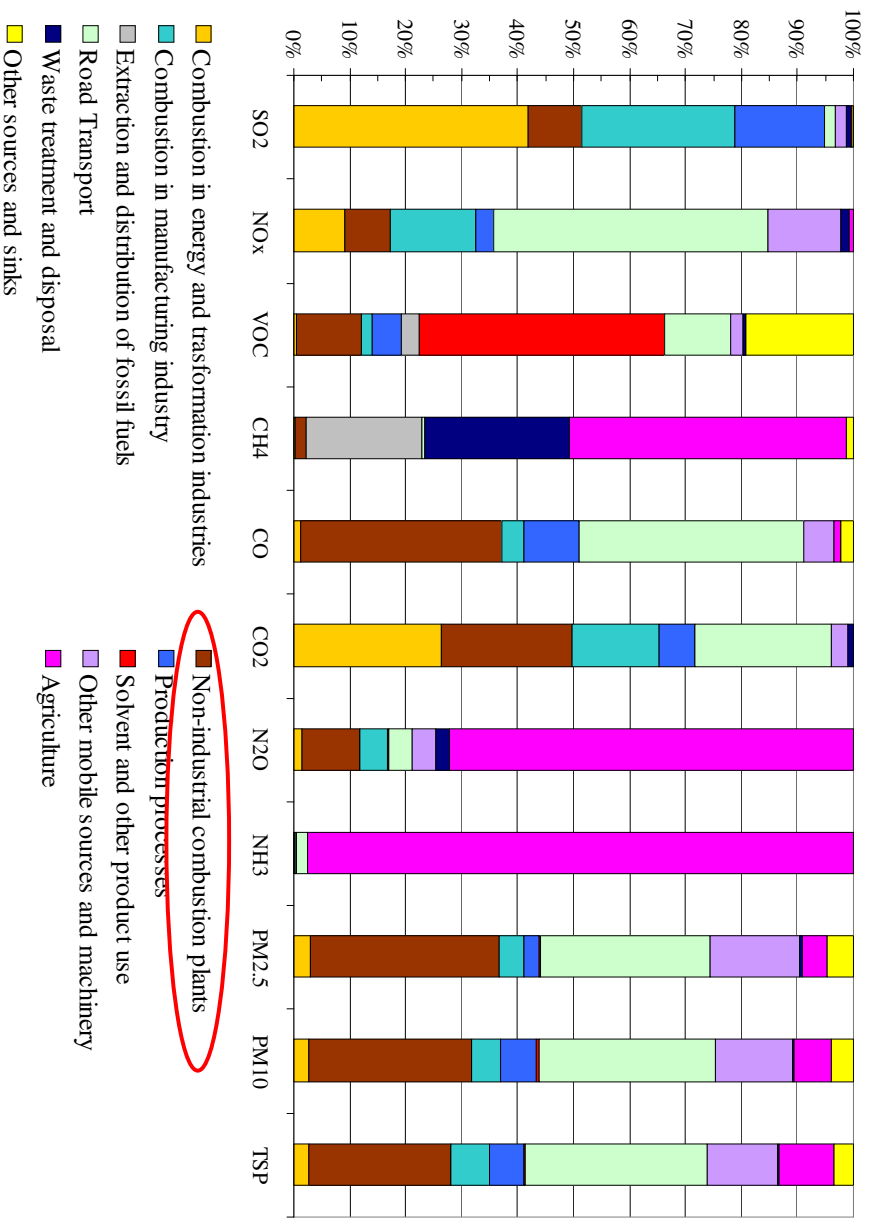
- with less than 65 % of thermal efficiency
- with CO emissions > 5000 ppm

→ The use of fireplaces is prohibited

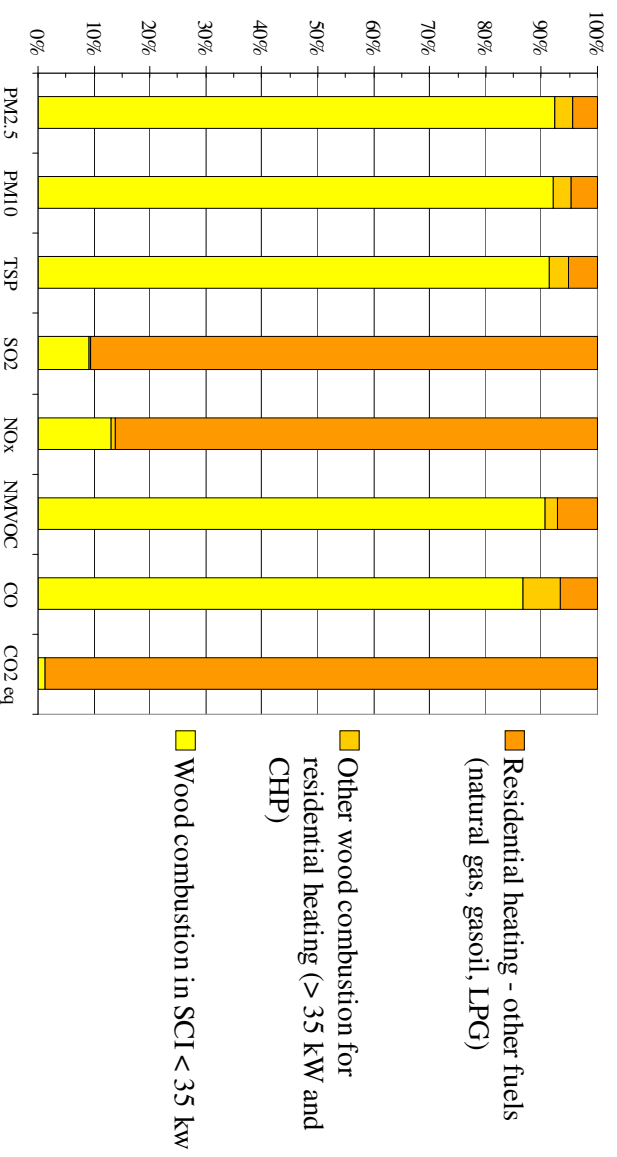
Small awareness, very few controls...

Fuel oil use for household heating has been prohibited since winter 2004/2005 in all Lombardy

Emissions in Lombardy by SNAP group (year 2007)

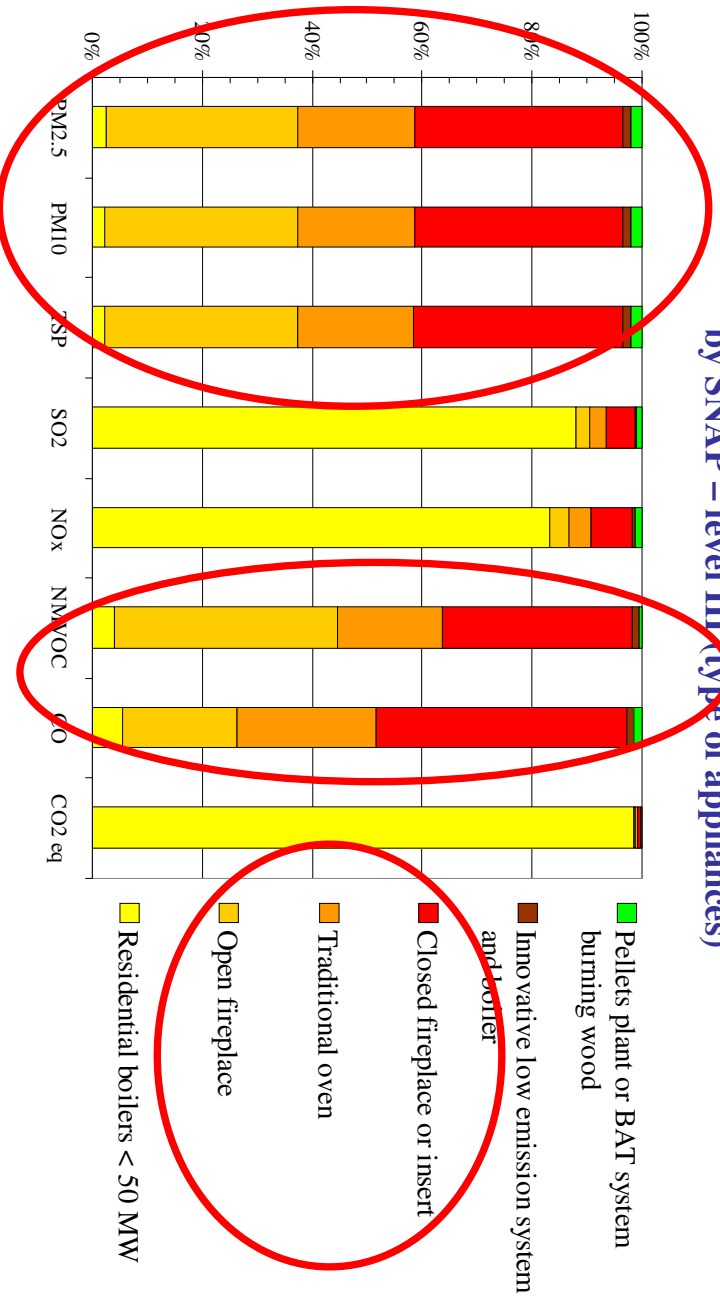


Lombardy 2007 emissions for domestic heating, CHP included



Although the number of SCI > 35 kW are increasing, their contribution to PM, VOC and CO emissions in Italy is very small if compared to emissions from SCI < 35 kW

The emission inventory consider five type of wood burning appliances;
one type (< 50 MW) is considered for gas and liquid SCI
**Lombardy 2007 emissions in the SNAP groups 2 - domestic heating,
by SNAP – level III (type of appliances)**



Emission come from very small combustion installation (< 35 kW)

The role of wood combustion as a source of PM has been confirmed by studies on the presence of wood tracers in air samples.

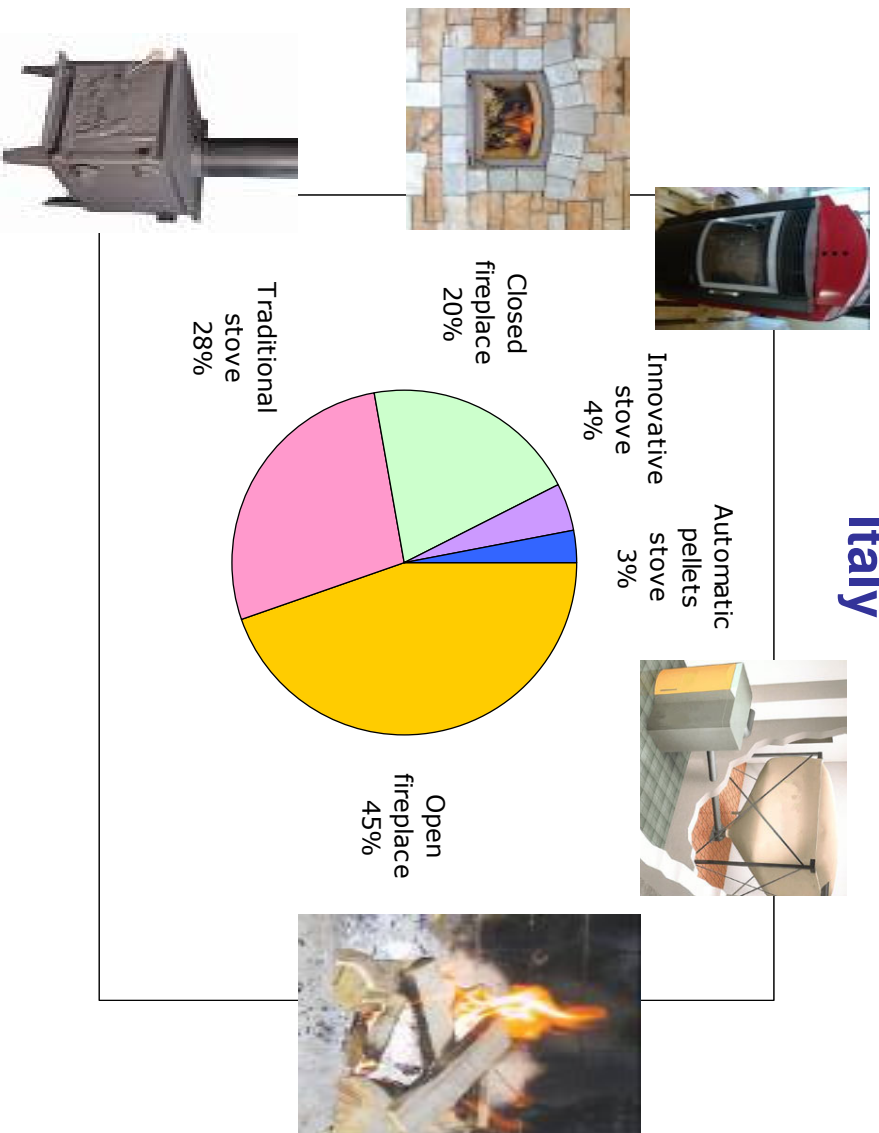
Although secondary aerosol formation is more relevant than primary emissions for both coarse and fine PM fraction, wood burning is relevant also in urban areas and strongly contributes to high peak of PM.

Critical point in the assessment of emission from small wood combustion installations

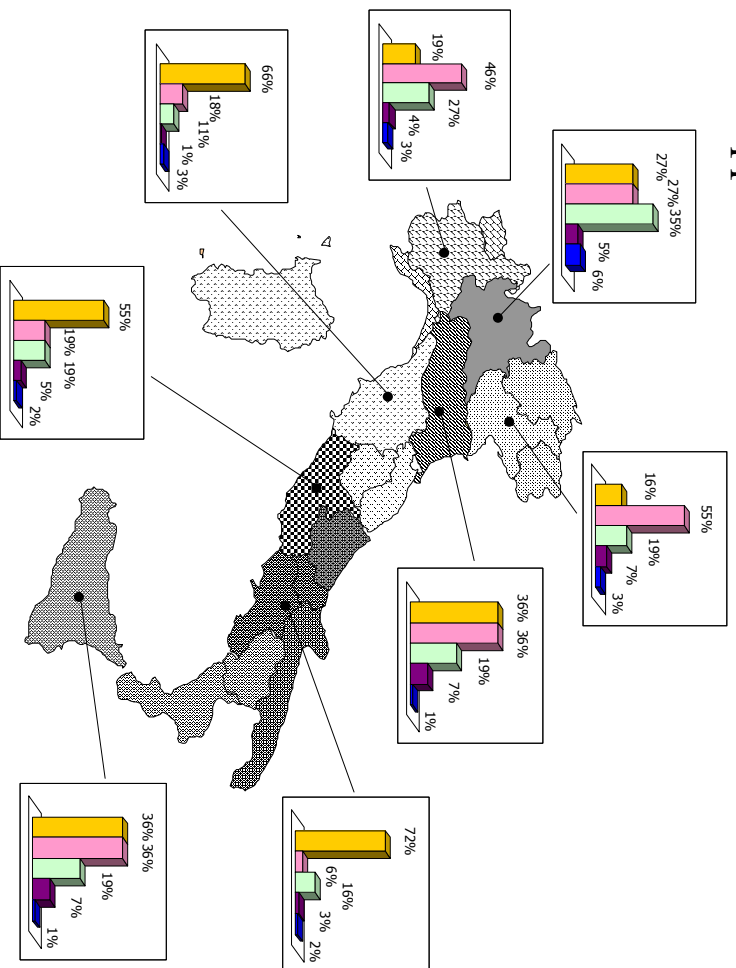
1. Assessment of wood consumption for different type of appliances
2. Assessment of actual emission factors (in the real operating conditions)

Distribution of wood combustion systems in Italy

Italy



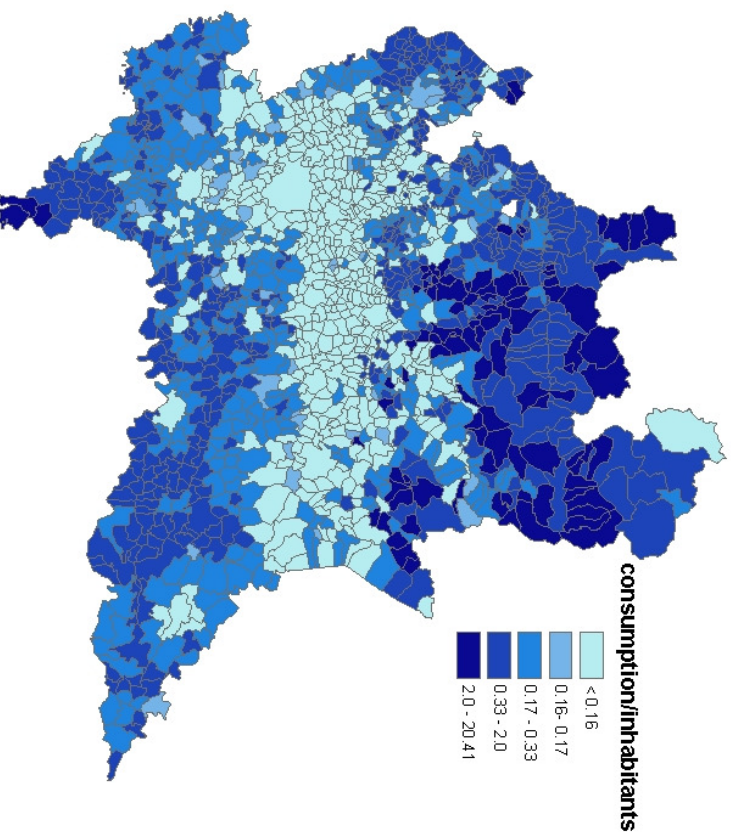
% number of appliances



■ Open fireplace
 ■ Traditional stove
 ■ Closed fireplace
 ■ Innovative stove
 ■ Automatic pellets stove

Source: Caserini S, et al. (2007) "New insight into the role of wood combustion as key PM source in Italy and in Lombardy region 15th US-EPA International Emission Inventory Conference. Raleigh, NC

Wood consumptions – pro capita in Lombardy



Source: Pastorello C, Dilara P. (2008) Estimation of residential wood combustion in Lombardy region. JRC report to Lombardy Region

Assessment of real emission factors

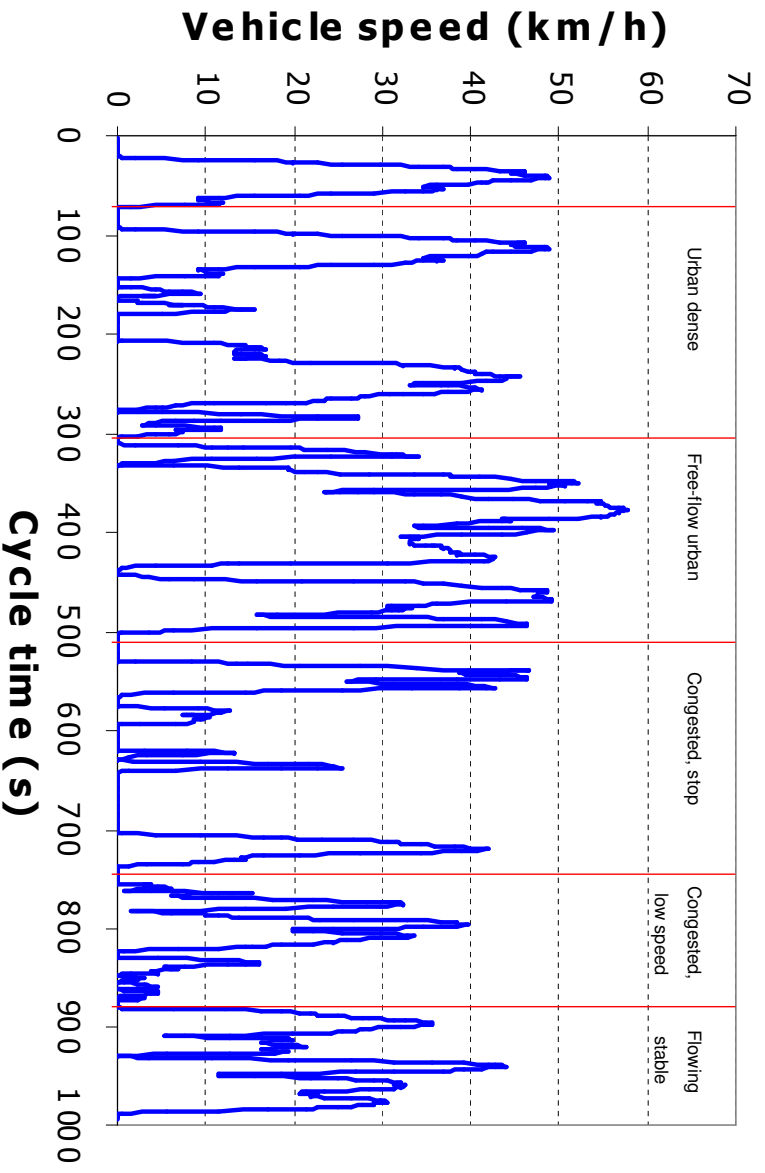
It is important to consider **the condensable fraction**, material that is vapor phase at stack conditions, but which condenses and/or reacts upon cooling and dilution in the ambient air to form solid or liquid PM immediately after discharge from the stack.

It is important to consider **emissions during transient conditions (start up)**

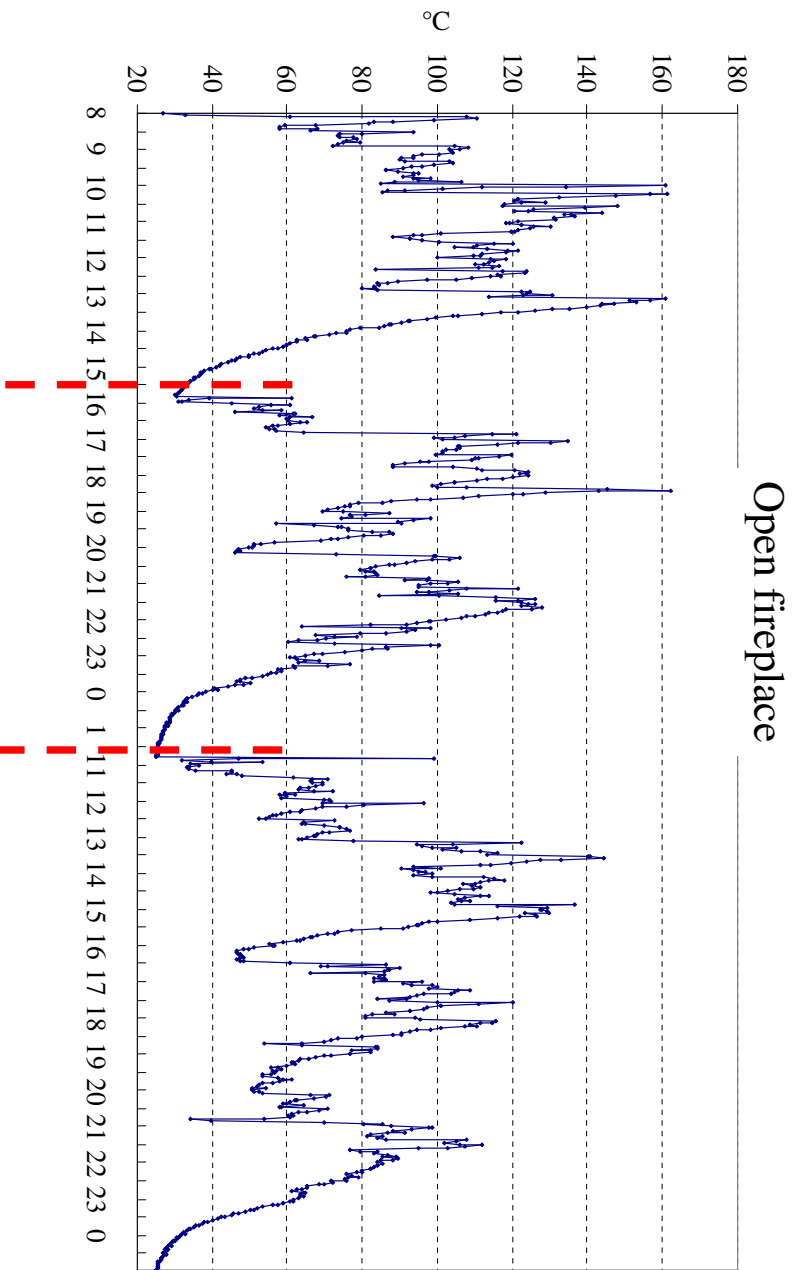
Need to consider the real burning cycle ?

Is type of wood relevant to the average EF ?

For road transport emission factor assessment, different reference
cycles has been defined
ARTEMIS urban



Real-life duty cycle for wood appliances (Temperature-time)



Source: Caserini S. – preliminary data

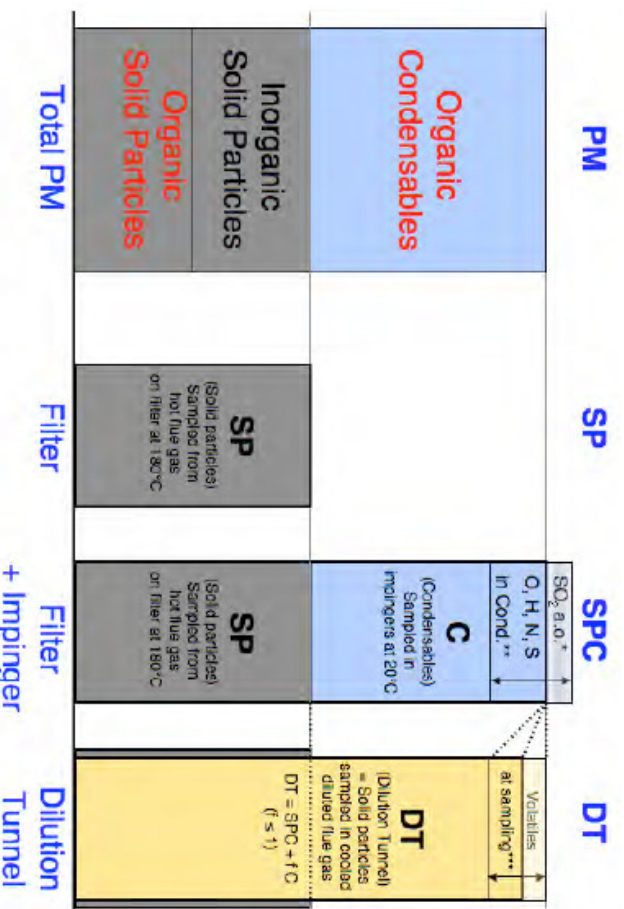


Figure 4.4

Comparison of different sampling methods with total PM in the flue gas. Explanations:

PM: Total Particulate Matter in flue gas at ambient temperature.

SP: Filter (Method a) resulting in solid particles SP.

SPC: Filter + Impinger (Method b) resulting in a PM measurement including SPC and most or all C.

DT: Dilution Tunnel (Method c) resulting in a PM measurement including SPC and most or all C.

Hence DT is identical or slightly smaller than SPC + C due to potentially incomplete condensation depending on dilution ratio and sampling temperature (since dilution reduces not only the temperature but also the partial pressure of contaminants).

Fonte: Nussbaumer T. et al. (2009) Particulate Emissions from Biomass Combustion in IEA Countries Survey on Measurements and Emission Factors ThomasInternational Energy Agency (IEA) Bioenergy Task 32. www.ieabcc.nl

Camini aperti

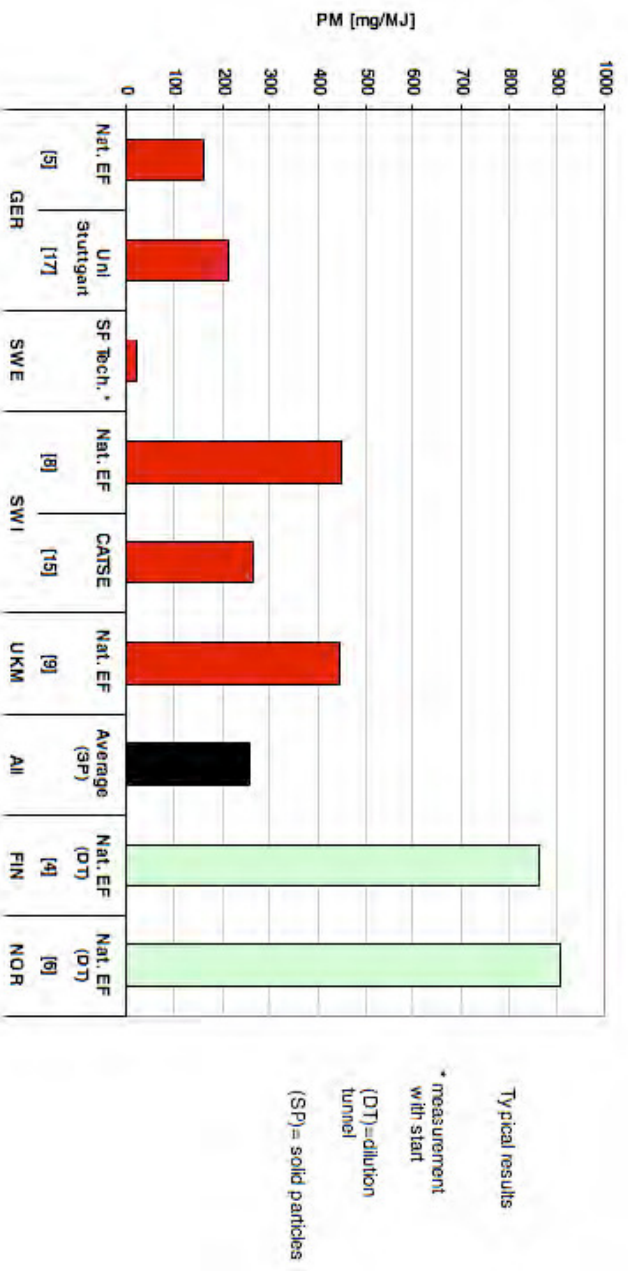


Figure 6.1 Emission factors for PM in mg/MJ for solid particles (SP, red) and for particles measured in dilution tunnel (DT, light green).

Fonte: Nussbaumer T. et al. (2009) Particulate Emissions from Biomass Combustion in IEA Countries Survey on Measurements and Emission Factors ThomasInternational Energy Agency (IEA) Bioenergy Task 32. www.ieabcc.nl

Camini chiusi e inserti

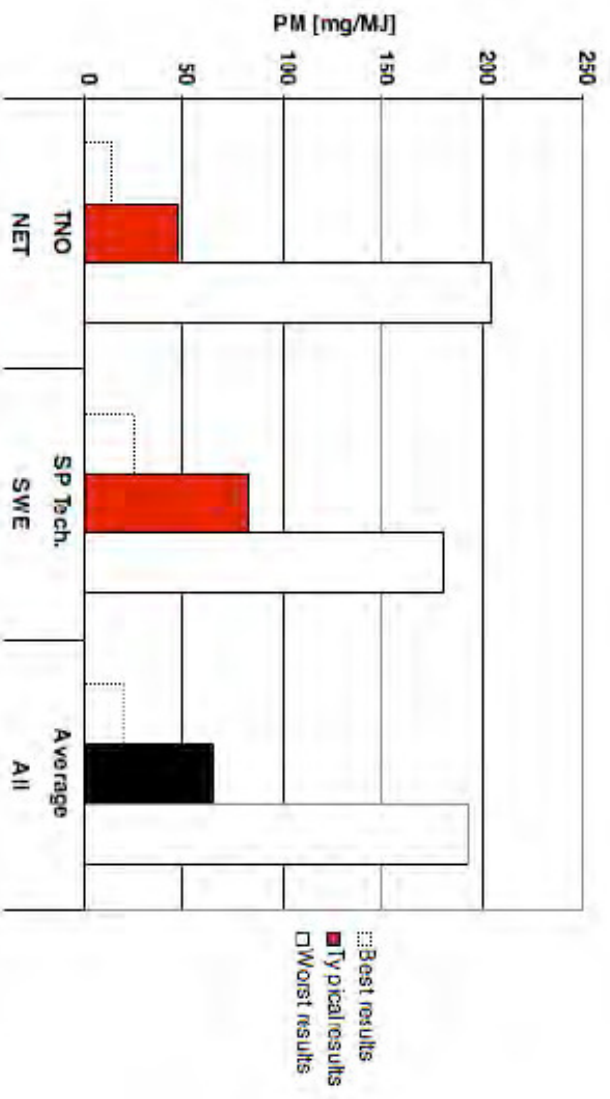


Figure 6.2 Emission factors for closed inset appliances indicated as solid particles (SP).

Fonte: Nussbaumer T. et al. (2009) Particulate Emissions from Biomass Combustion in IEA Countries Survey on Measurements and Emission Factors ThomasInternational Energy Agency (IEA) Bioenergy Task 32. www.ieabcc.nl

Stufe

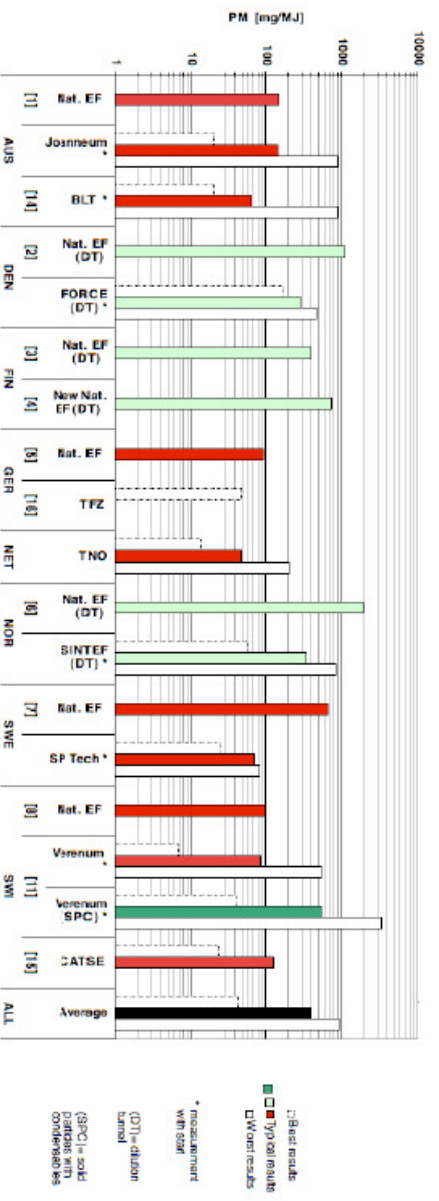


Figure 6.3 Range of emission factors from worst to best (where available) for wood stoves depending of type of operation and/or equipment. Red = SP, light green = DT, dark green = SPC, black = average.

Fonte: Nussbaumer T. et al. (2009) Particulate Emissions from Biomass Combustion in IEA Countries Survey on Measurements and Emission Factors ThomasInternational Energy Agency (IEA) Bioenergy Task 32. www.ieabcc.nl

Caldaie a ciocchi di legna

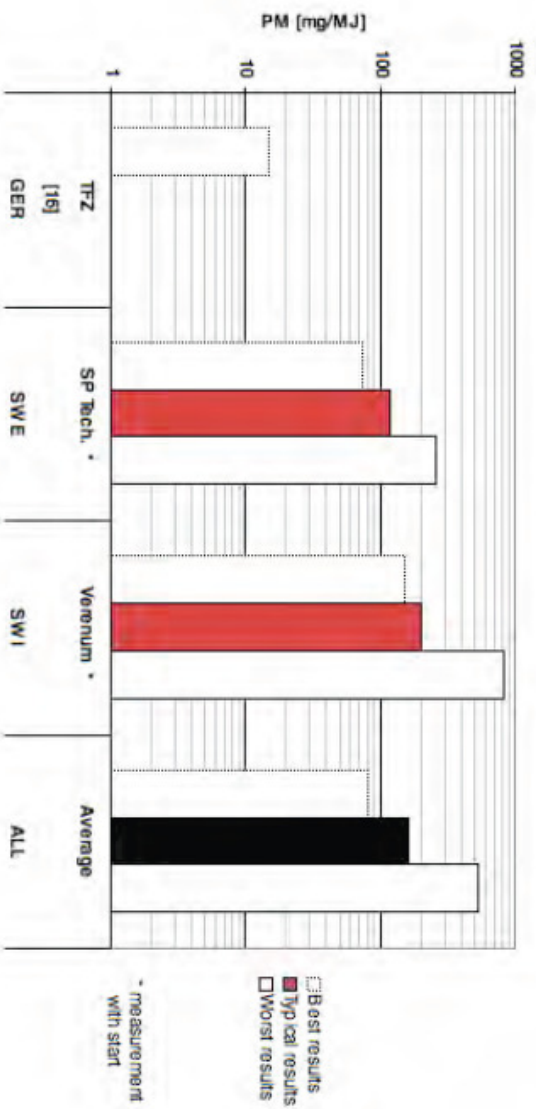


Figure 6.6 Range of emission factors from worst to best (where available) for log wood boilers with updraft combustion without ventilator.

Fonte: Nussbaumer T. et al. (2009) Particulate Emissions from Biomass Combustion in IEA Countries Survey on Measurements and Emission Factors ThomasInternational Energy Agency (IEA) Bioenergy Task 32. www.ieabcc.nl

Impianti e caldaie a pellets

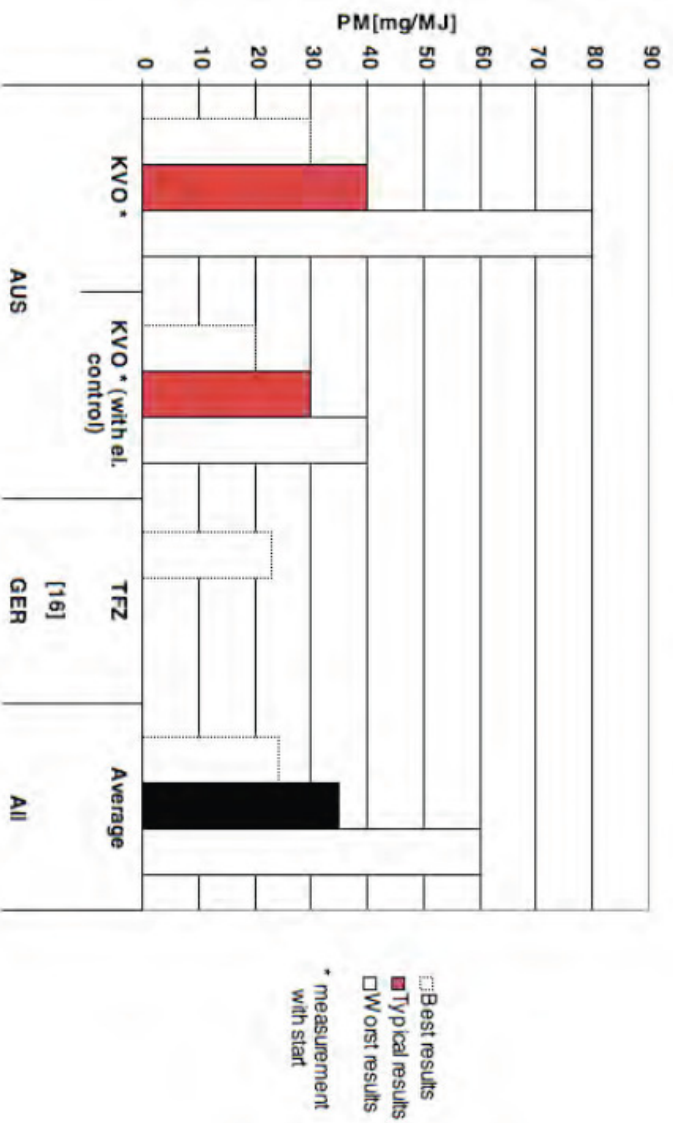


Figure 6.10 Range of emission factors from worst to best (where available) for pellet stoves with natural draft.

Fonte: Nussbaumer T. et al. (2009) Particulate Emissions from Biomass Combustion in IEA Countries Survey on Measurements and Emission Factors ThomasInternational Energy Agency (IEA) Bioenergy Task 32. www.ieabcc.nl

Impianti e caldaie a pellets

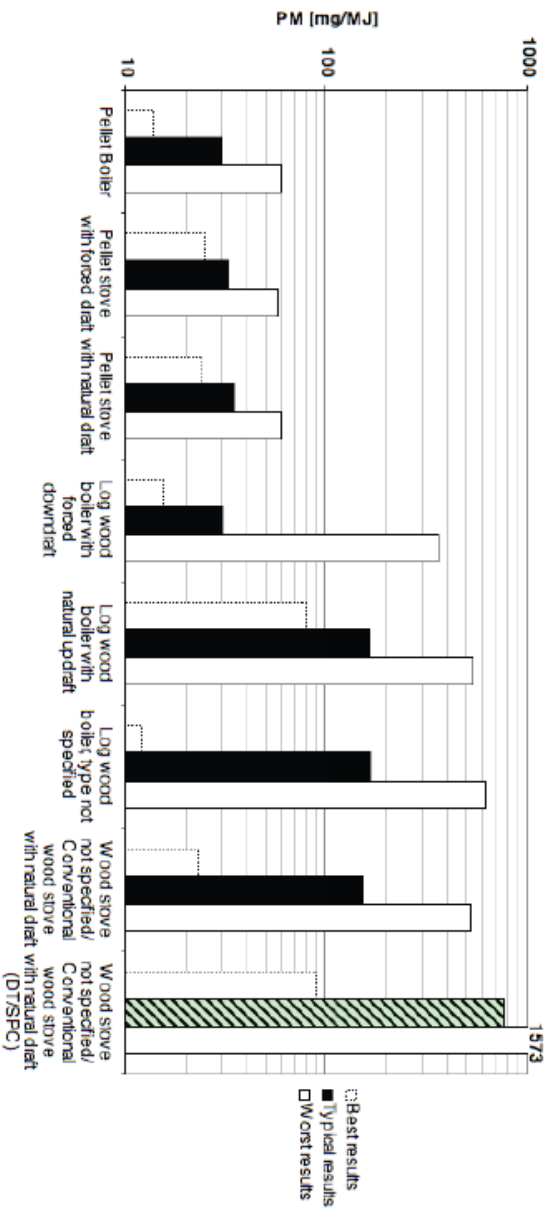
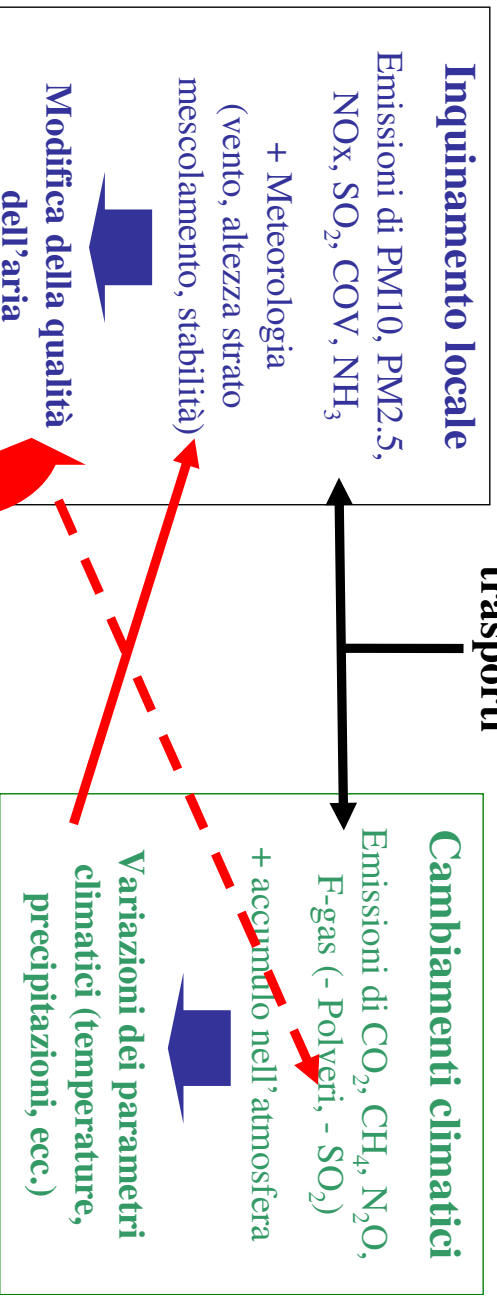


Figure 6-13 Average emission factors (best, typical, worst) for pellet boilers, pellet stoves, log wood boilers, and wood stoves. All data indicated as solid particles SP except for wood stoves, where data including condensables (SPC) or measured in dilution tunnel are given additionally in the last column.

Fonte: Nussbaumer T. et al. (2009) Particulate Emissions from Biomass Combustion in IEA Countries Survey on Measurements and Emission Factors ThomasInternational Energy Agency (IEA) Bioenergy Task 32. www.ieabcc.nl

Attività energetiche, produzioni industriali, trasporti



- Variazione di:
- Temperatura
 - Precipitazioni
 - Ventosità
 - H strato mescolamento
 - Stabilità dell'atmosfera

Novità

ruolo importante della “fuliggine” (“black carbon”, “soot”) particolato molto fine, cancerogeno e con effetto riscaldante i sul clima