Agenzia Regionale
per la Protezione dell'Ambiente
della Lombardia

ARPA

New insight into the role of wood combustion as key PM source in Italy and in Lombardy region

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Outline:

- Introduction
- Methodology
- Results
- Conclusions

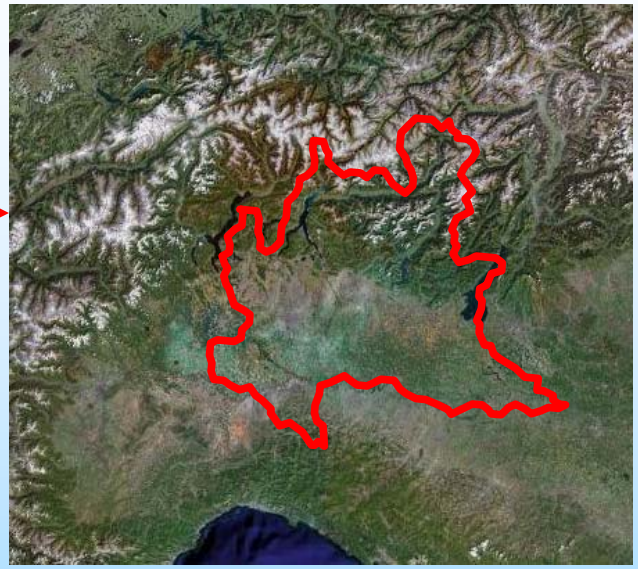
Pescocostanzo (Abruzzo region, August 2006)

Introduction

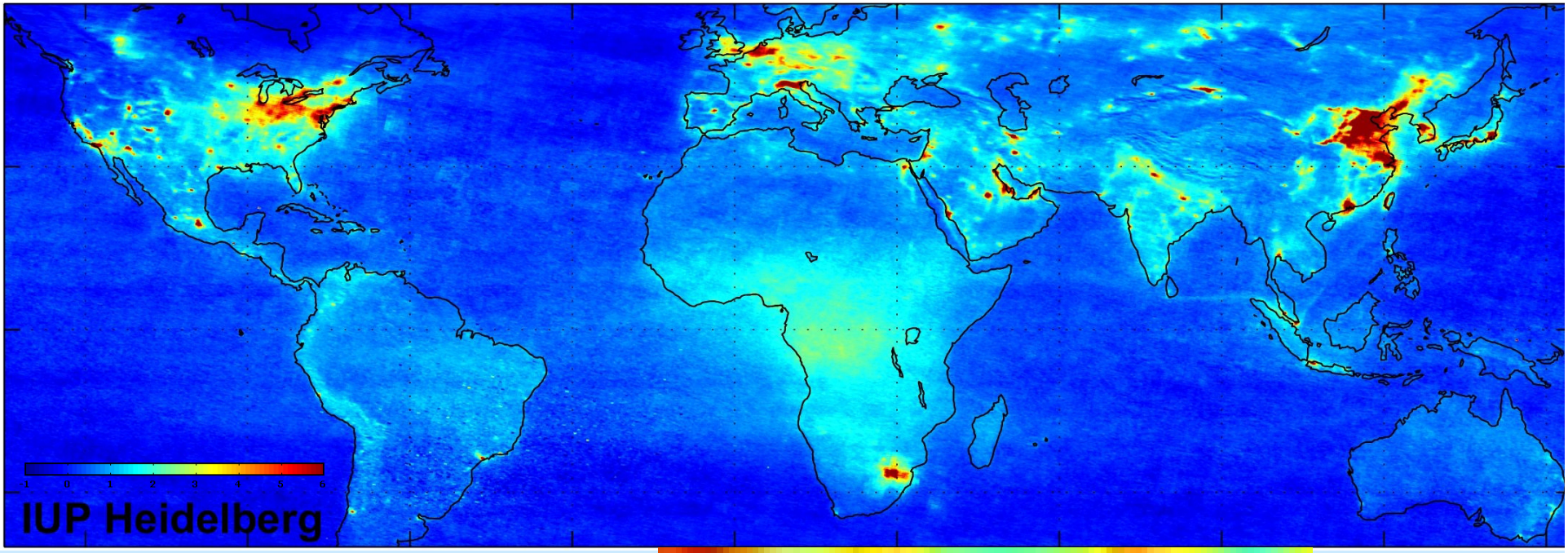
Italy

56 Mil. inhabitants

Lombardy

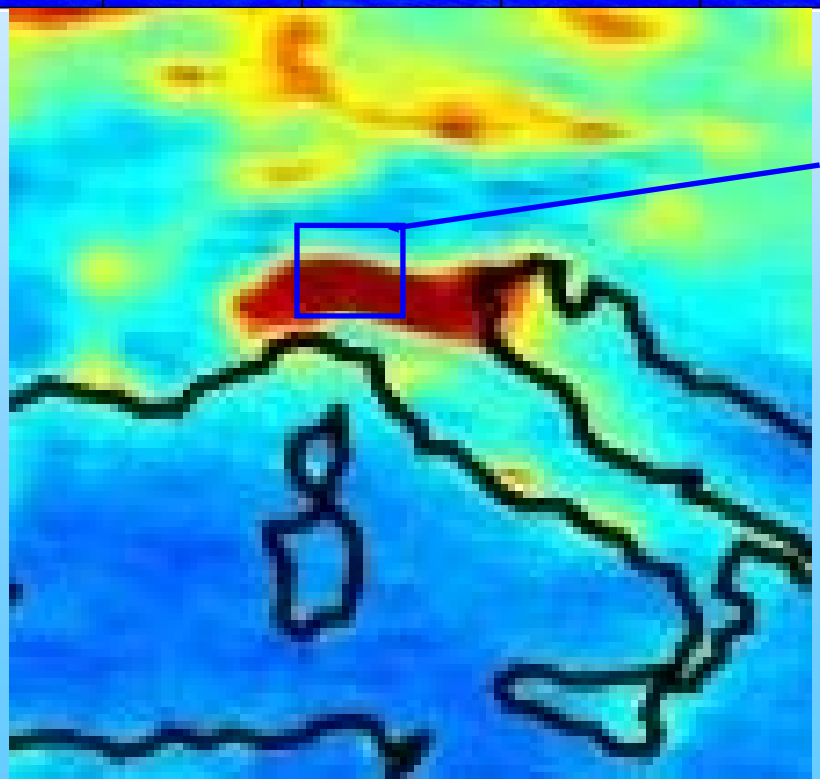


9 Mil. inhabitants



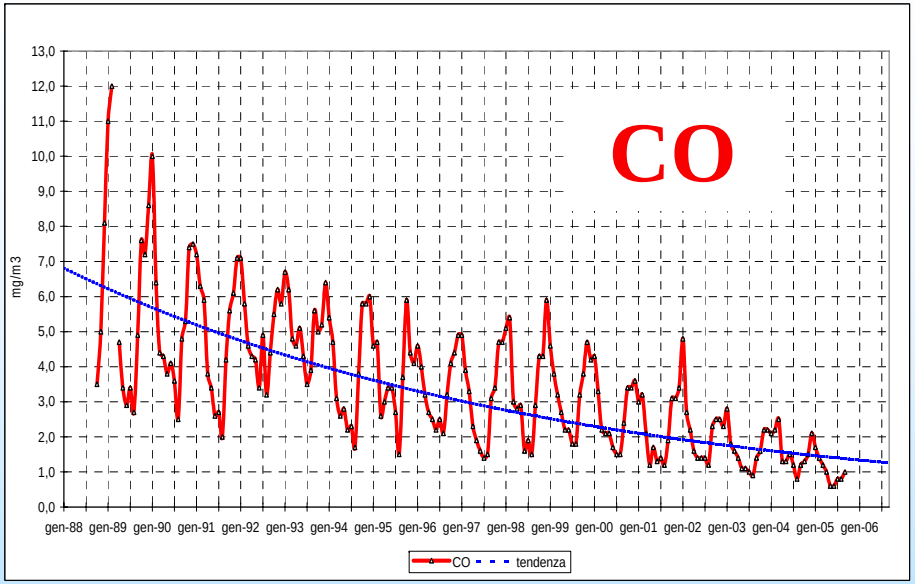
Global mean tropospheric nitrogen dioxide (NO_2) vertical column density between January 2003 and June 2004, as measured by the SCIAMACHY instrument on ESA's Envisat

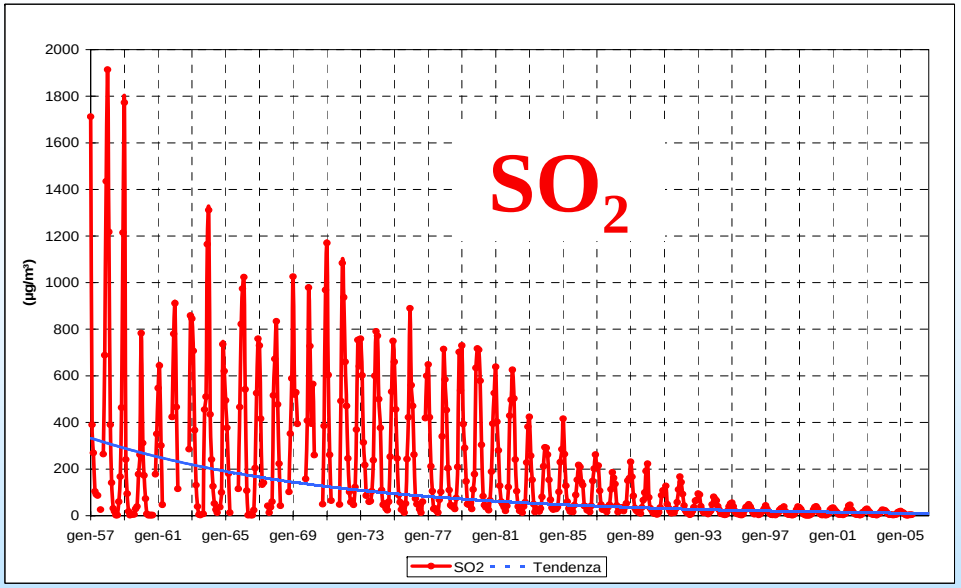
http://www.esa.int/esaCP/SEM340NKPZD_index_1.html

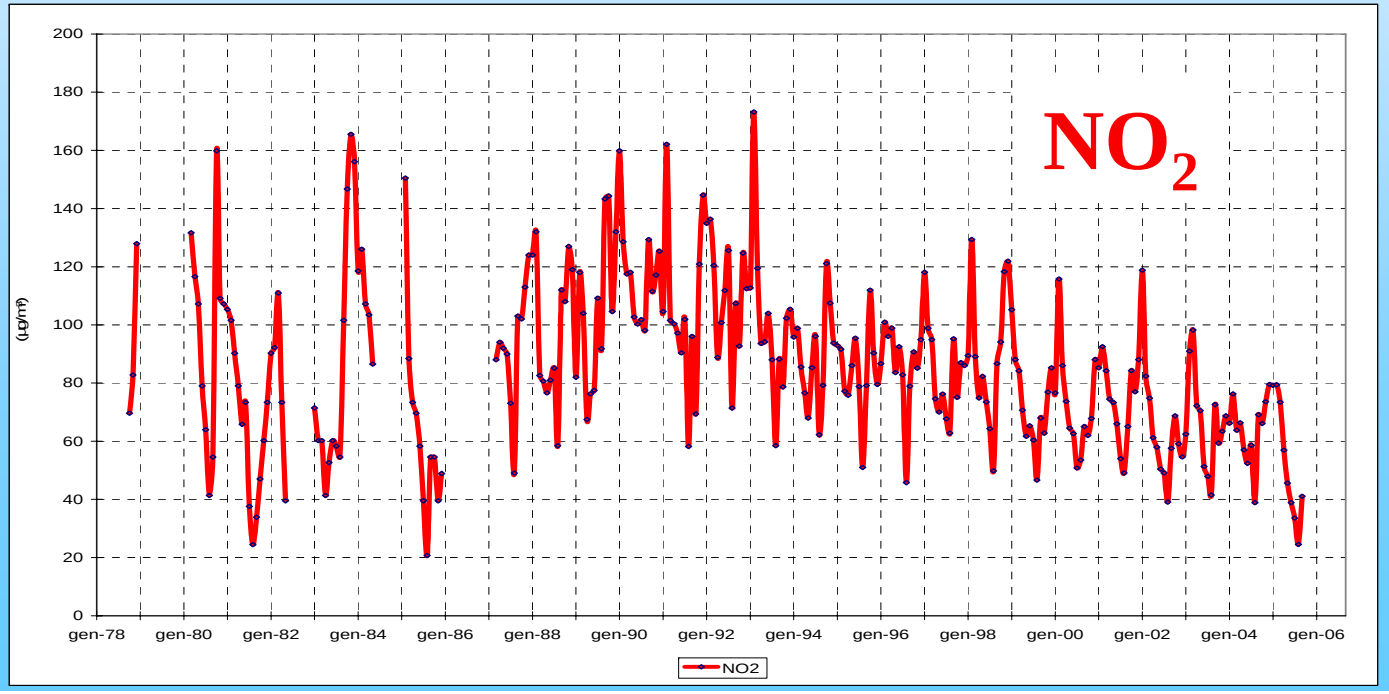


Lombardy Region

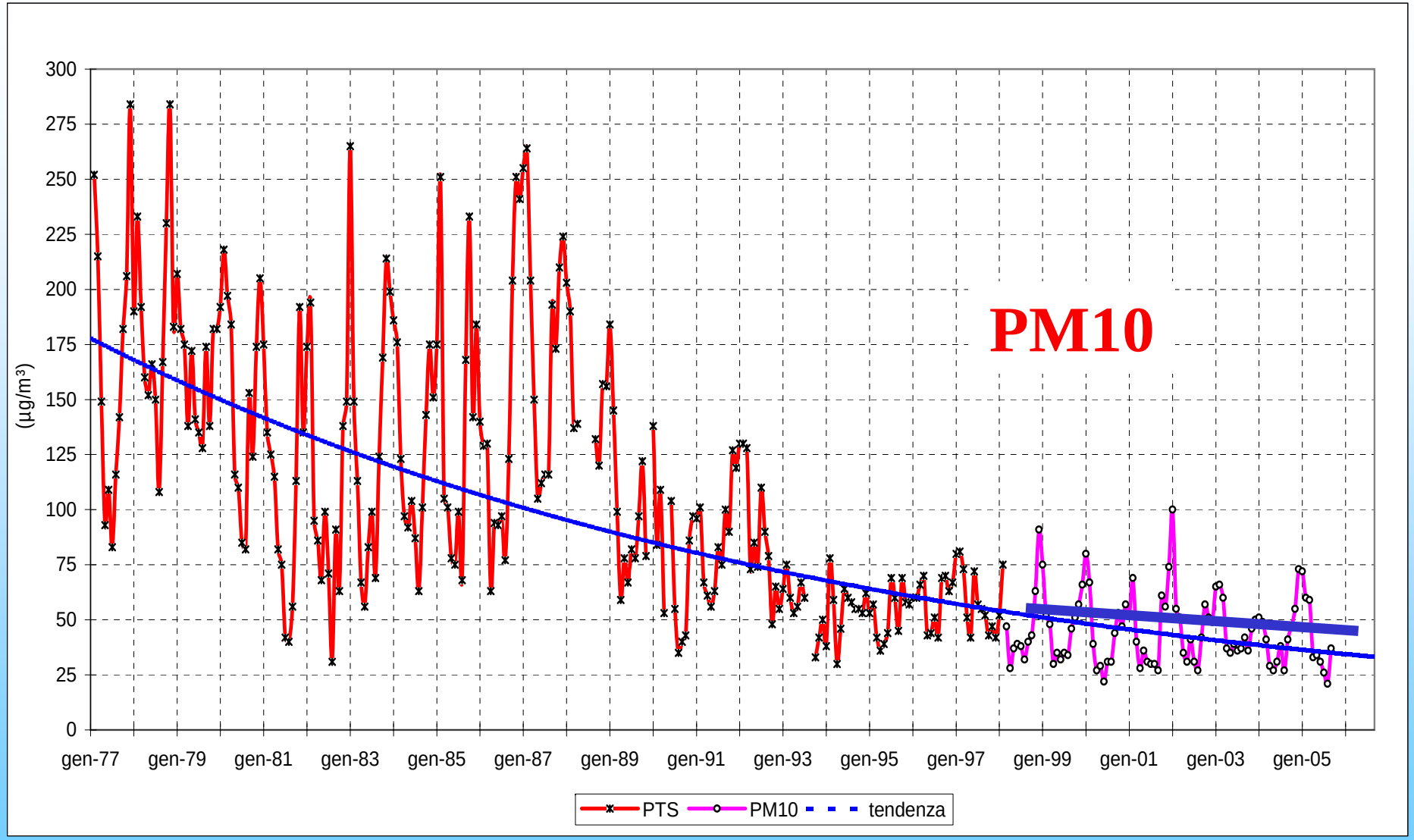
Air quality trend in Milano area 1/2





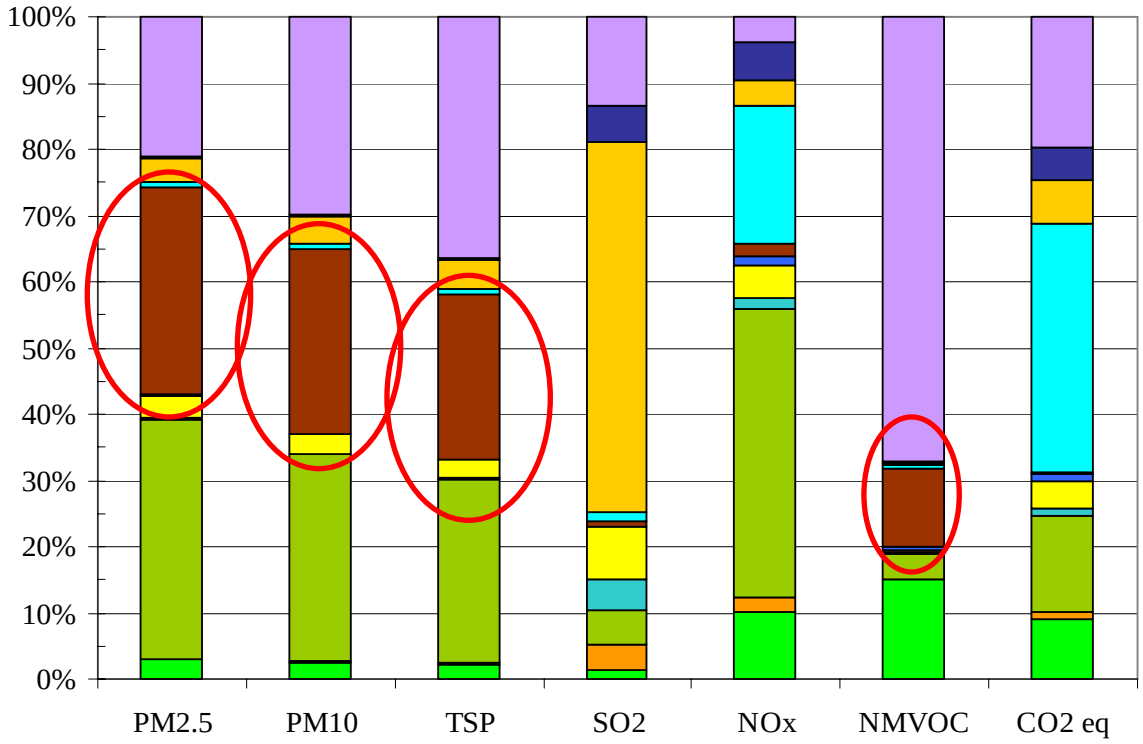


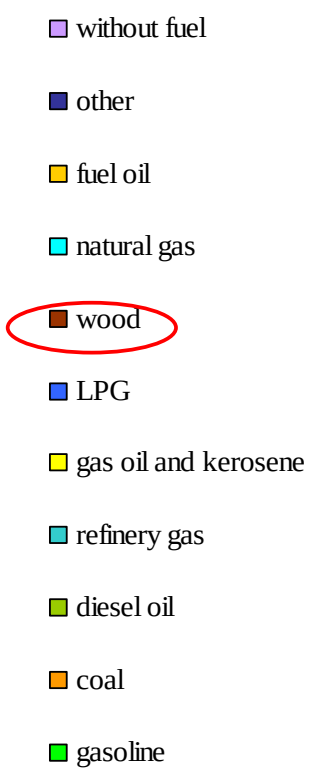
Air quality trend in Milano area 2/2



PM is decreasing slowly

Wood combustion has been identified in the Italian and Lombardy emission inventory as an important source of primary PM10 emissions





Lombardy 2003 emissions by fuel

In Lombardy, wood combustion in appliances with less than 65 % of thermal efficiency has been prohibited in winter 2006/2007, in every municipality in the plain (altitude < 300 meters)

ARPA Lombardia (Regional Environmental Protection Agency) and APAT (National Environmental Protection Agency) decide to further investigate data on wood consumption.

The research has been funded by APAT and realized in the winter 2006 by Arpa Lombardia and C.R.A. Customized Research & Analysis

Previous works highlighted the relevant use of wood for residential heating in Italy and in Lombardy

- At the national level (ENEA, Italian Agency for Energy, New technologies and environment): survey in 1997 and in 1999
- At the Lombardy Region level (Lombardy Foundation for the Environment *): survey among 30.000 middle school students in 2004

* Caserini S., Marazzi L. et al. (2005) "Extensive survey on wood use for domestic heating in Lombardy: implication for PM emission inventory," 14th US-EPA International Emission Inventory Conference Las Vegas, 11-14/4/2005,

Methodology

ARPA/APAT 2006 survey combine two methods:

- CATI (Computer Assisted Telephone Interviewing)
- Telepanel (representative panel of the Italian population connected to the data center via PC)

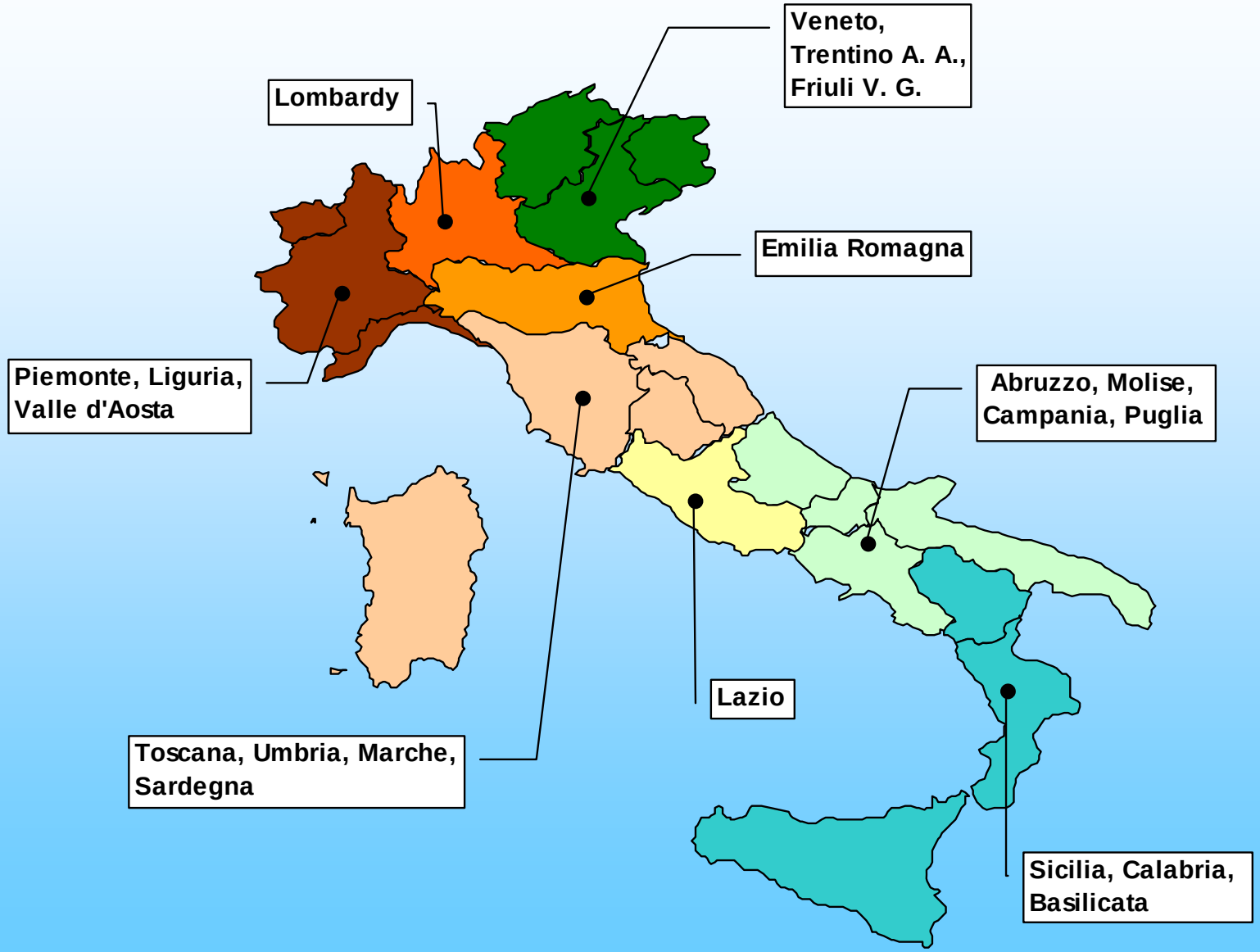
→ 5,000 families

Sample processed and expanded to the reference universe (21 million families) by usual statistical inference techniques

Sample grouped by four layers:

- macro-regions (8)
- size of settlements (5)
- altitude (3)
- number of family members (5)

8 macro-regions



Other layers

3 altitude layers:

- Plain (up to 300 m)
- Hill (from 300 to 600 m)
- Mountain (over 600 m)

5 size of settlements layers :

- Up to 5,000 inhabitants
- from 5,001 to 20,000
- from 20,001 to 50,000
- from 50,001 to 100,000
- more than 100,000 inhabitants

5 number of members layers:

- one member
- 2 members
- 3 members
- 4 members
- 5 members and more

Diffusion of wood use

≅ **26**% of Italian families use wood for domestic uses

85% in the residence house

→ 10% in the holiday home

5% in both of them

Regular use of wood, i.e. more than 4 times a year

→ **about 20% of families**

Use of wood is more common

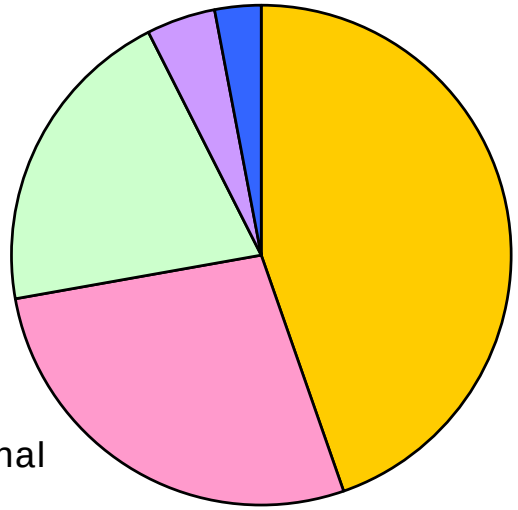
- in mountains and hills
- in single buildings
- in towns below 5,000 inhabitants
- for domestic heating (70%) rather than cooking (30%)

Distribution of wood combustion systems

Automatic pellets stove 3%

Innovative stove 4%

Closed fireplace 20%



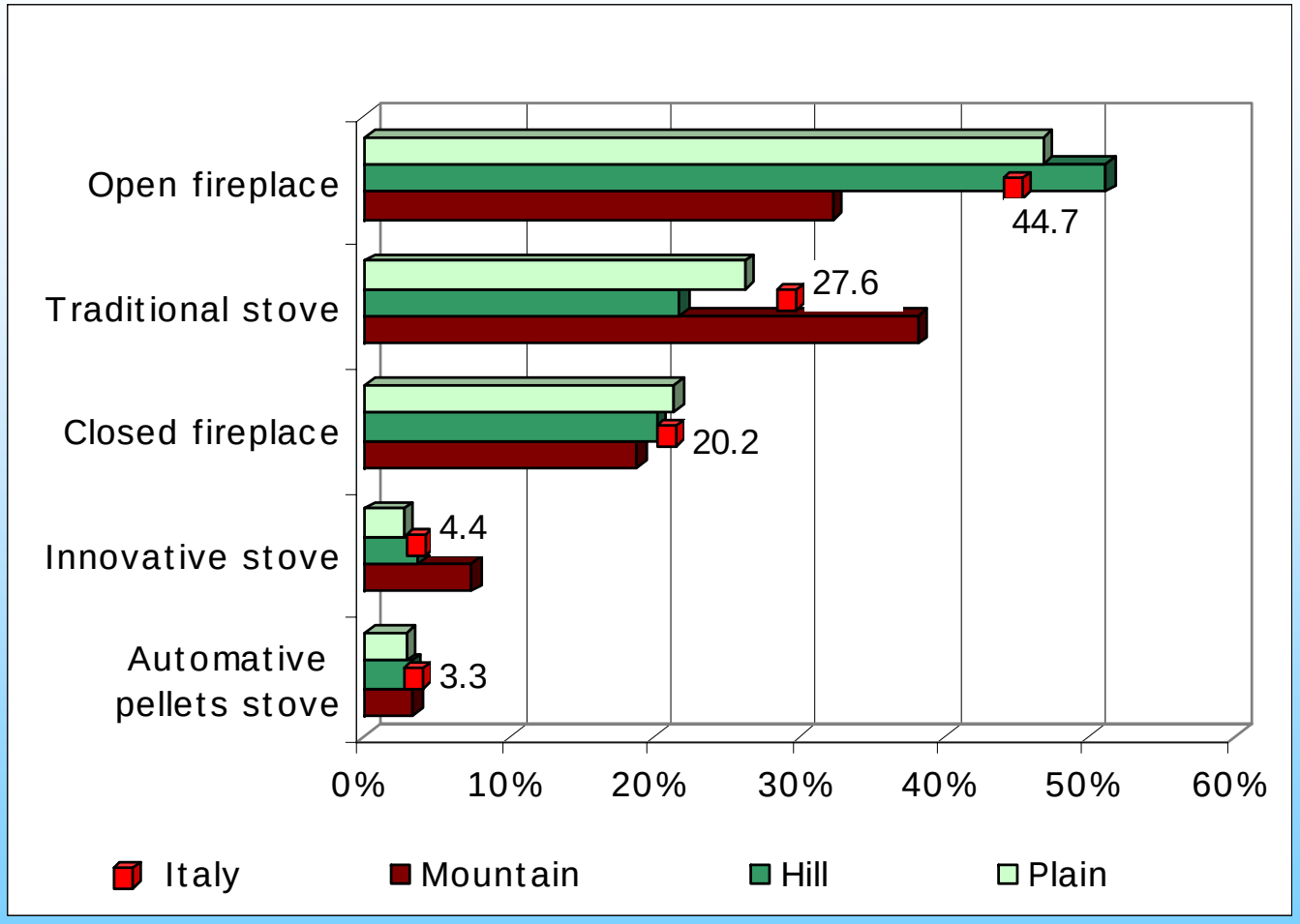
Open fireplace 45%

Traditional stove 28%

An average of 1.3 appliance / household

Distribution of wood combustion systems:

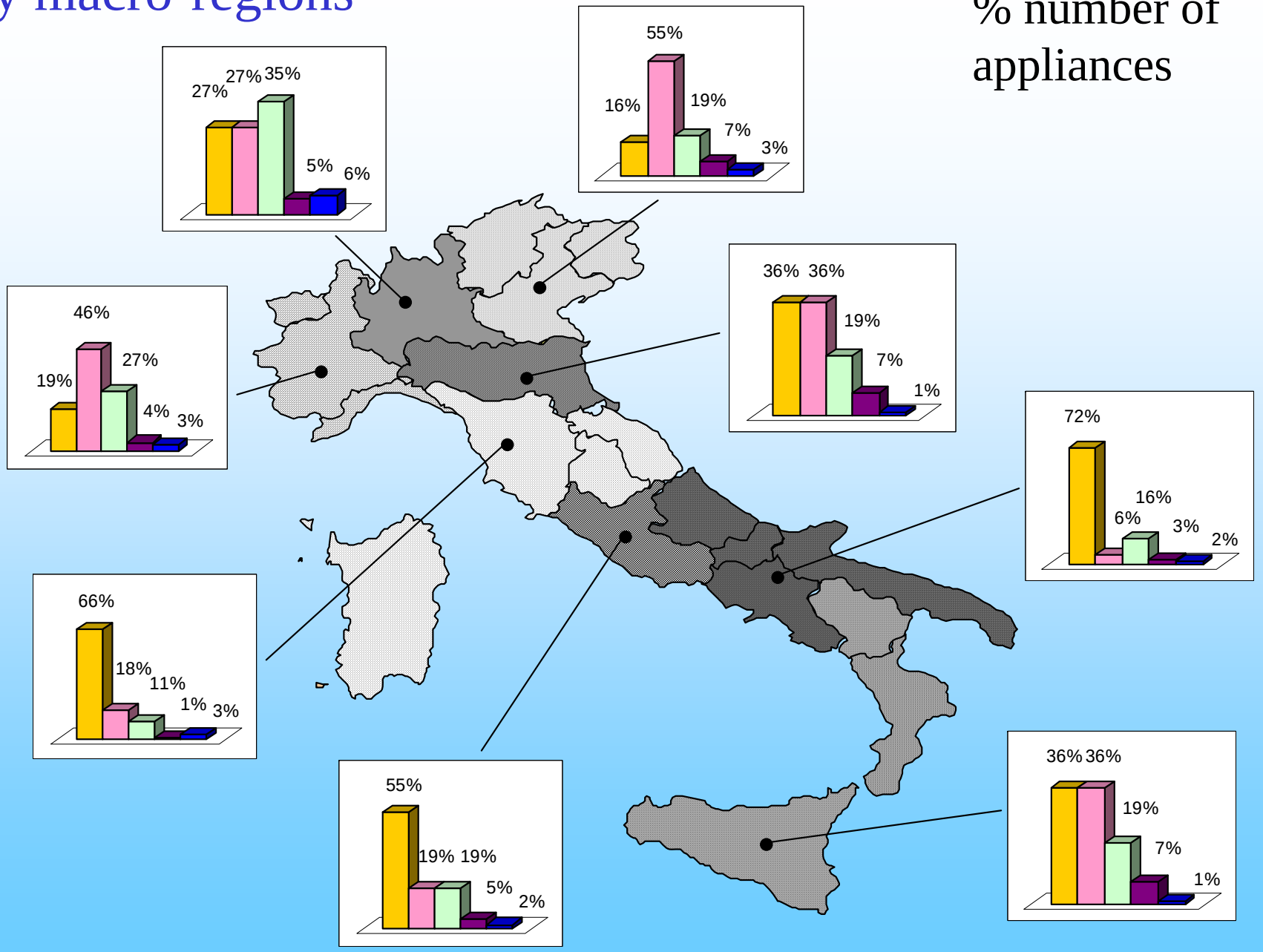
1) by altitude



Stoves are more used in the mountain
whereas the open fireplace is more common in the hills.

2) By macro-regions

% number of appliances

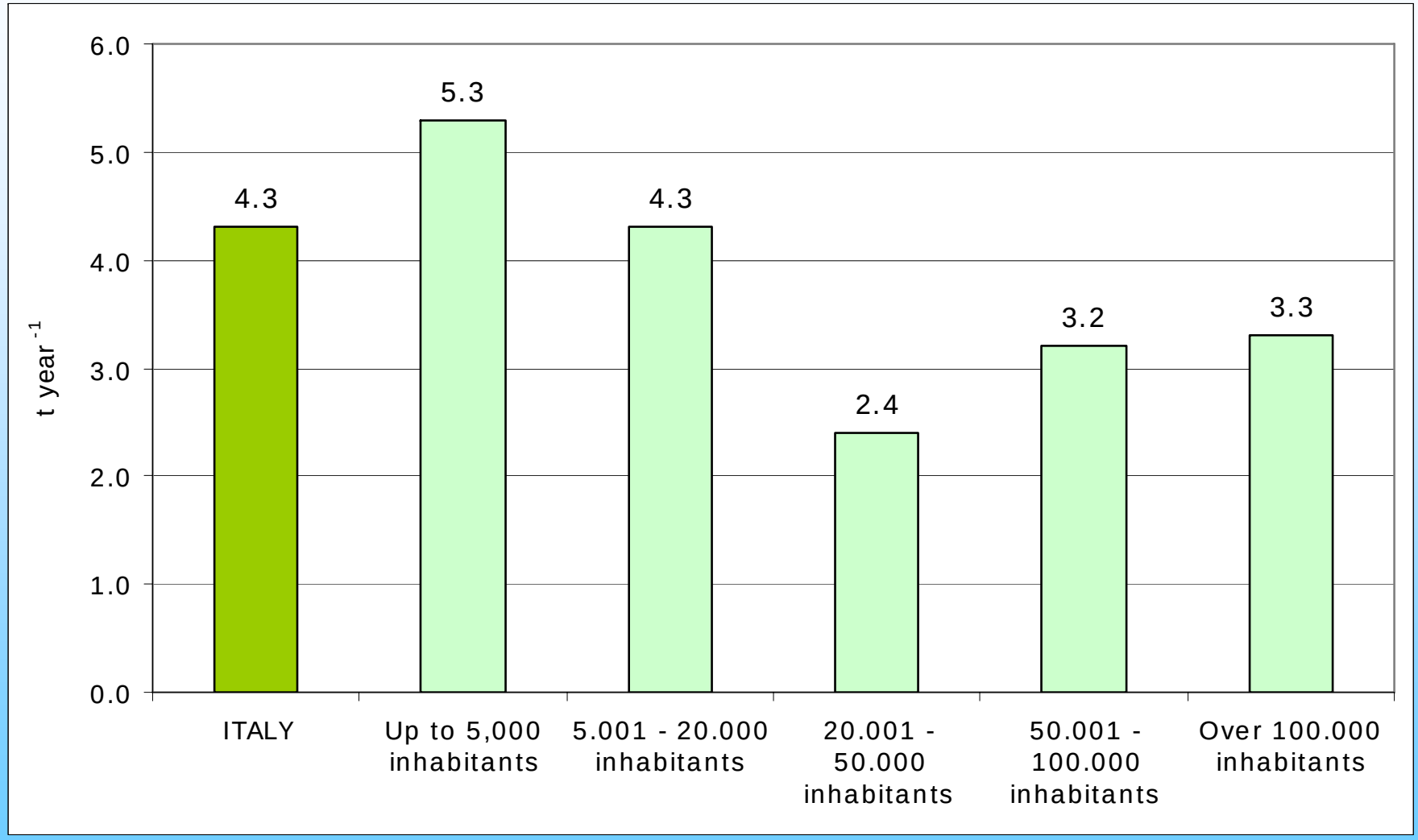


Open fireplace | Traditional stove | Closed fireplace | Innovative stove | Automatic pellets stove

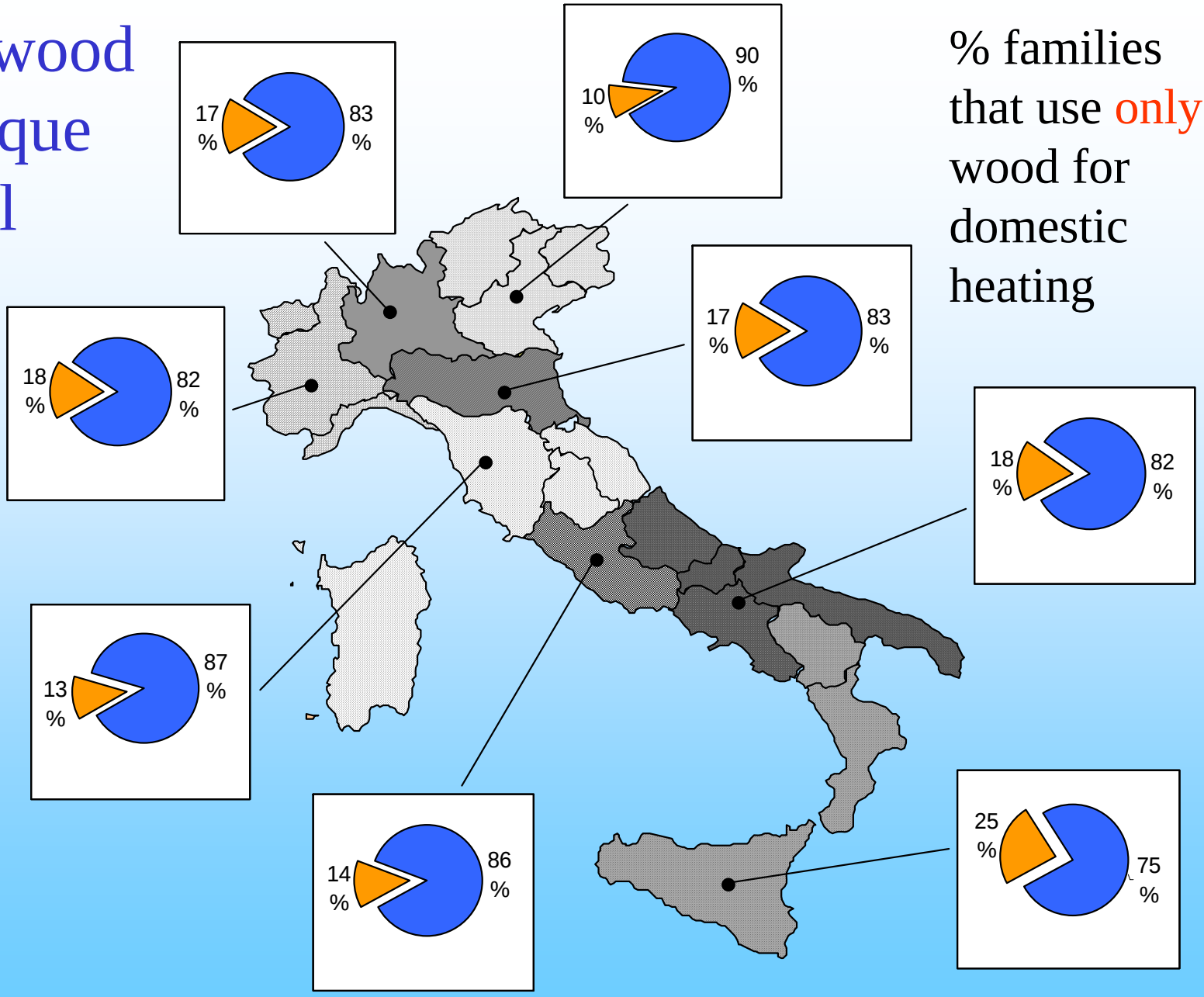
Wood consumptions – by macro-regions

	Households	**%**	**Wood consumptions** t	**%**	**Wood consumptions per household** t
ITALY	**4,432,419**	**100 %**	**19,119,481**	**100 %**	**4.3**
Piemonte + Liguria + Valle d'Aosta	480,115	10.8 %	2,268,662	11.9 %	4.7
Lombardy	594,396	13.4 %	2,034,035	10.6 %	3.4
Veneto + Trentino A. A. + Friuli V. G.	656,140	14.8 %	3,112,048	16.3 %	4.7
Emilia Romagna	271,260	6.1 %	932,336	4.9 %	3.4
Toscana + Marche + Umbria + Sardegna	752,458	17.0 %	3,461,665	18.1 %	4.6
Lazio	404,453	9.1 %	1,707,416	8.9 %	4.2
Abruzzo + Molise + Campania + Puglia	782,329	17.7 %	3,350,698	17.5 %	4.3
Sicilia + Calabria + Basilicata	491,269	11.1 %	2,252,622	11.8 %	4.6

Wood consumptions – by size of settlements

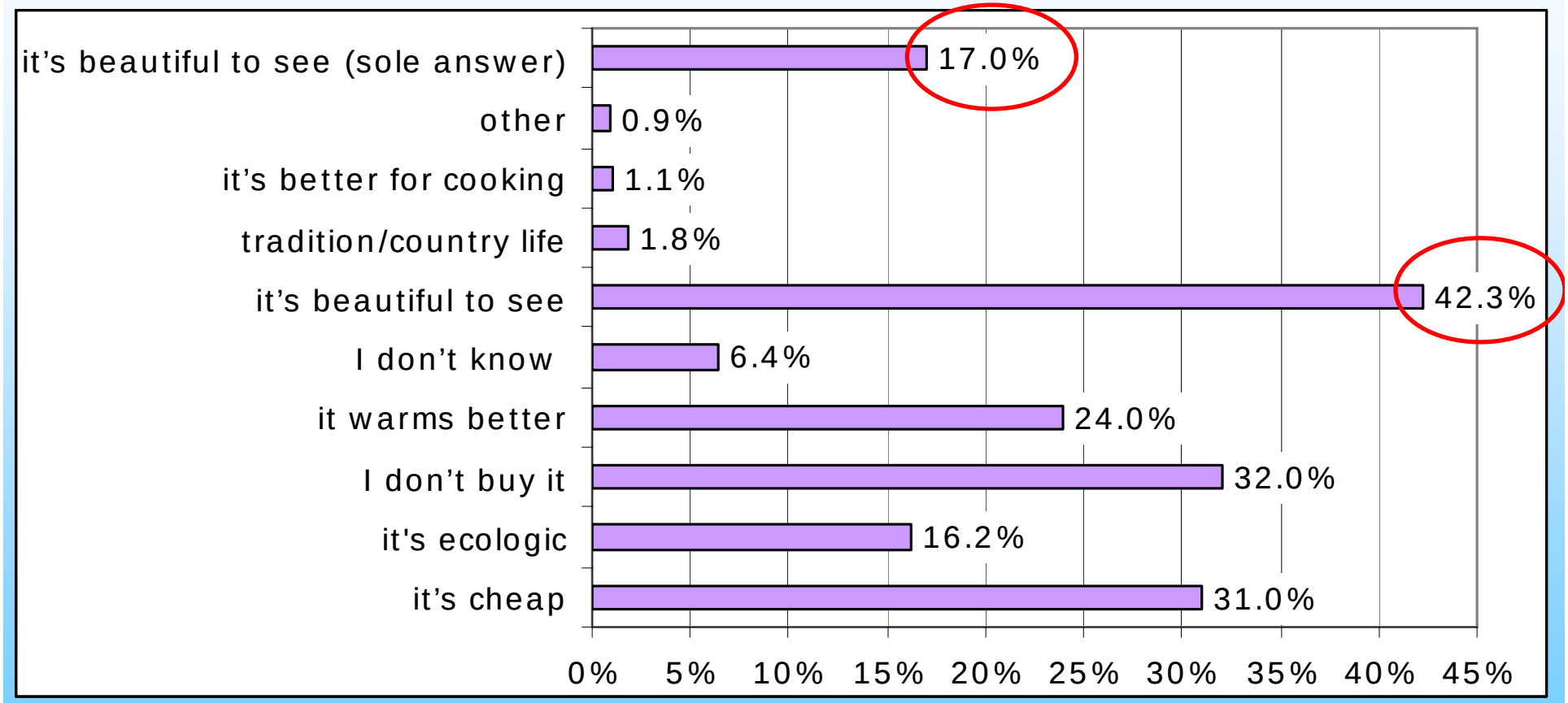


Use of wood as unique fuel



% families that use only wood for domestic heating

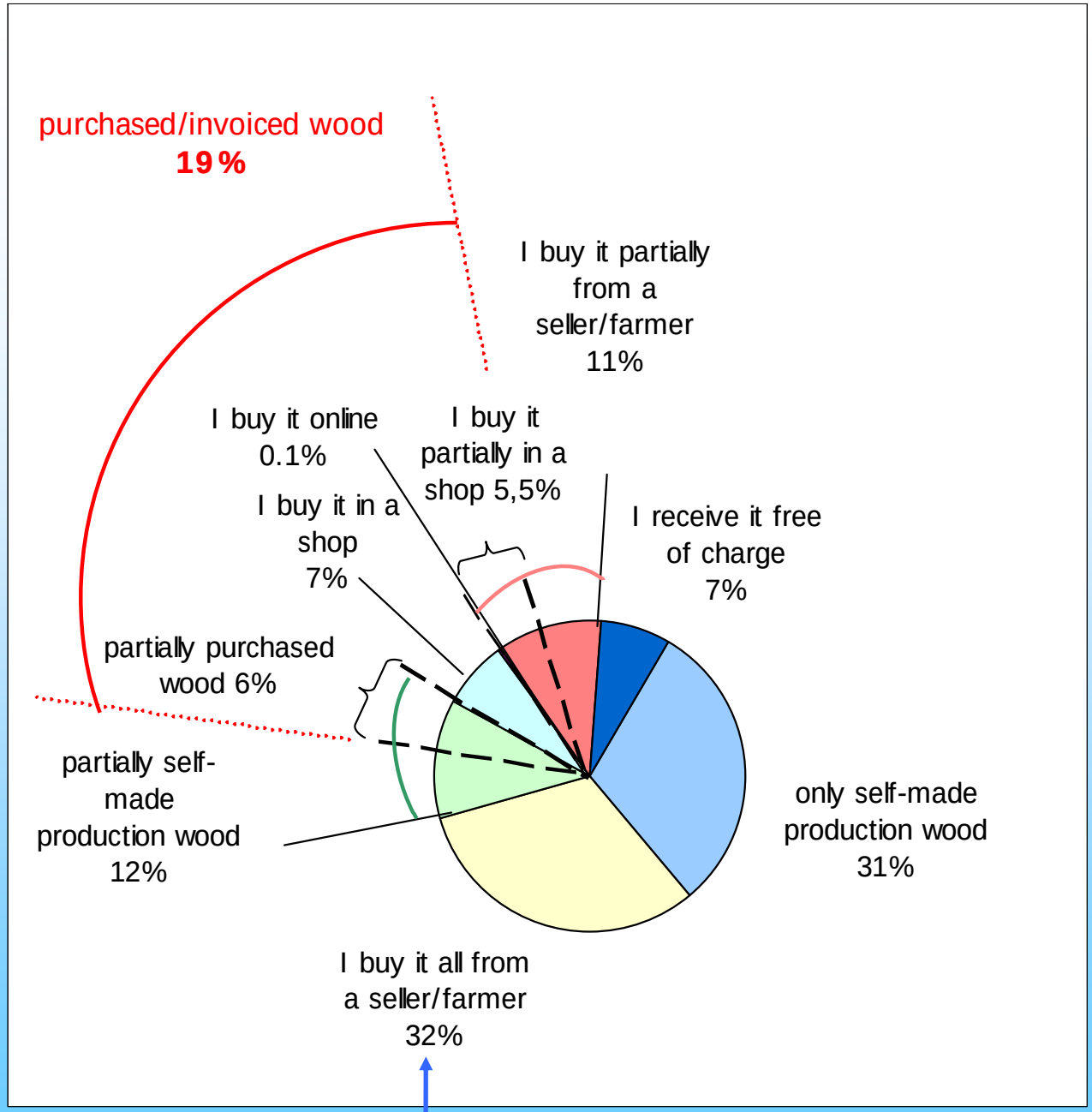
Reasons to prefer a wood combustion system
(multiple answers)



Supplying means

Approximately a balance between self-made production and purchase.

Only ≅ 20% of wood burnt is “recorded” in official statistics, as invoiced or purchased (≅ 3.8 Mt vs. 20 Mt).



Farmers don’t give a receipt…

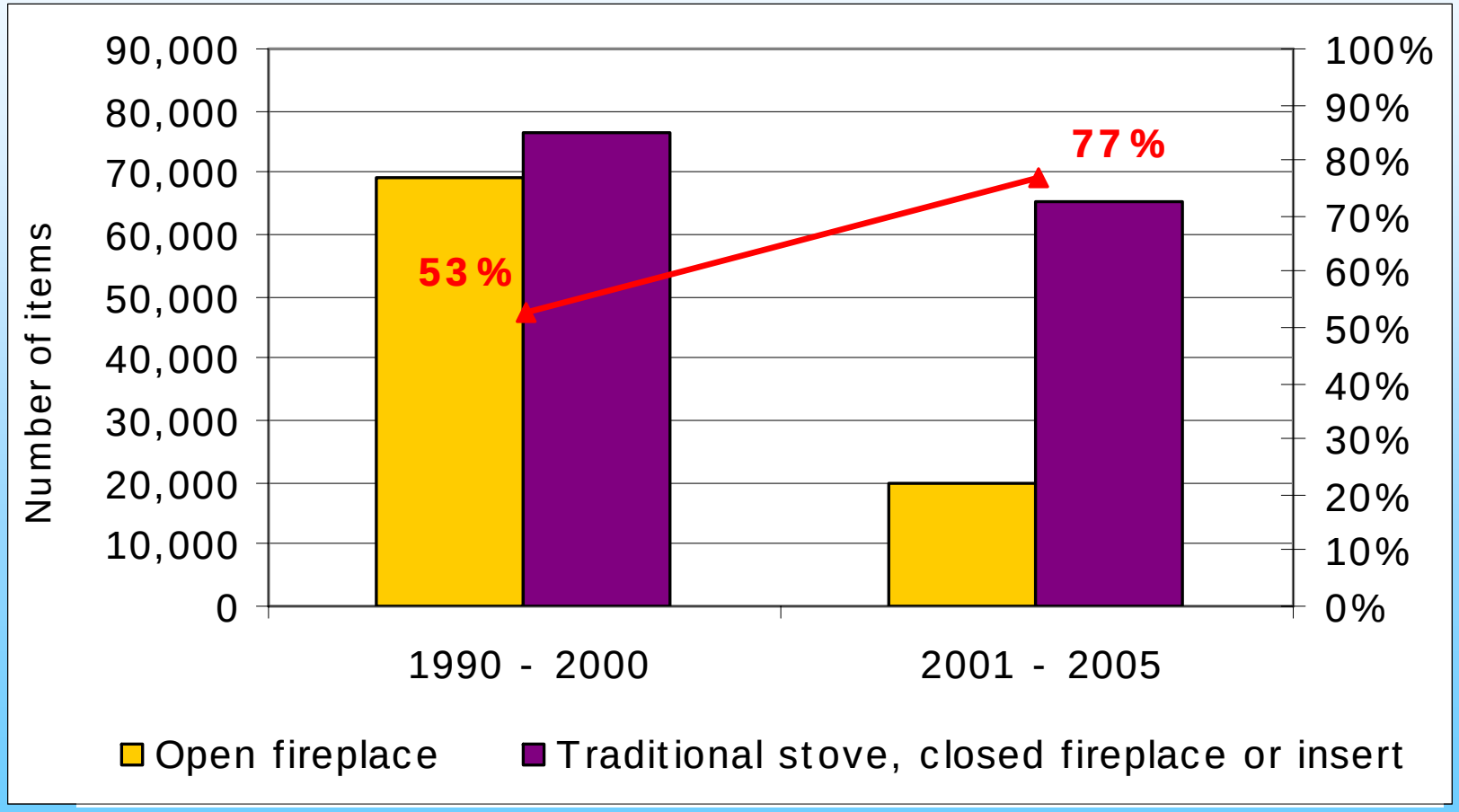
Tendency to purchase new wood combustion systems

The 5.1% of the sample affirm the intention of changing their combustion system with an innovative stove (total cost about € 2,000) if an incentive of € 500 would be provided; with an incentive of € 1,000 this percentage rises only to 6.6%.

Sure purchase of an automatic stove (a system where pellets or chips are automatically fed) with a incentives of € 300 - € 1,000:
3.3 - 4.3% of the sample.

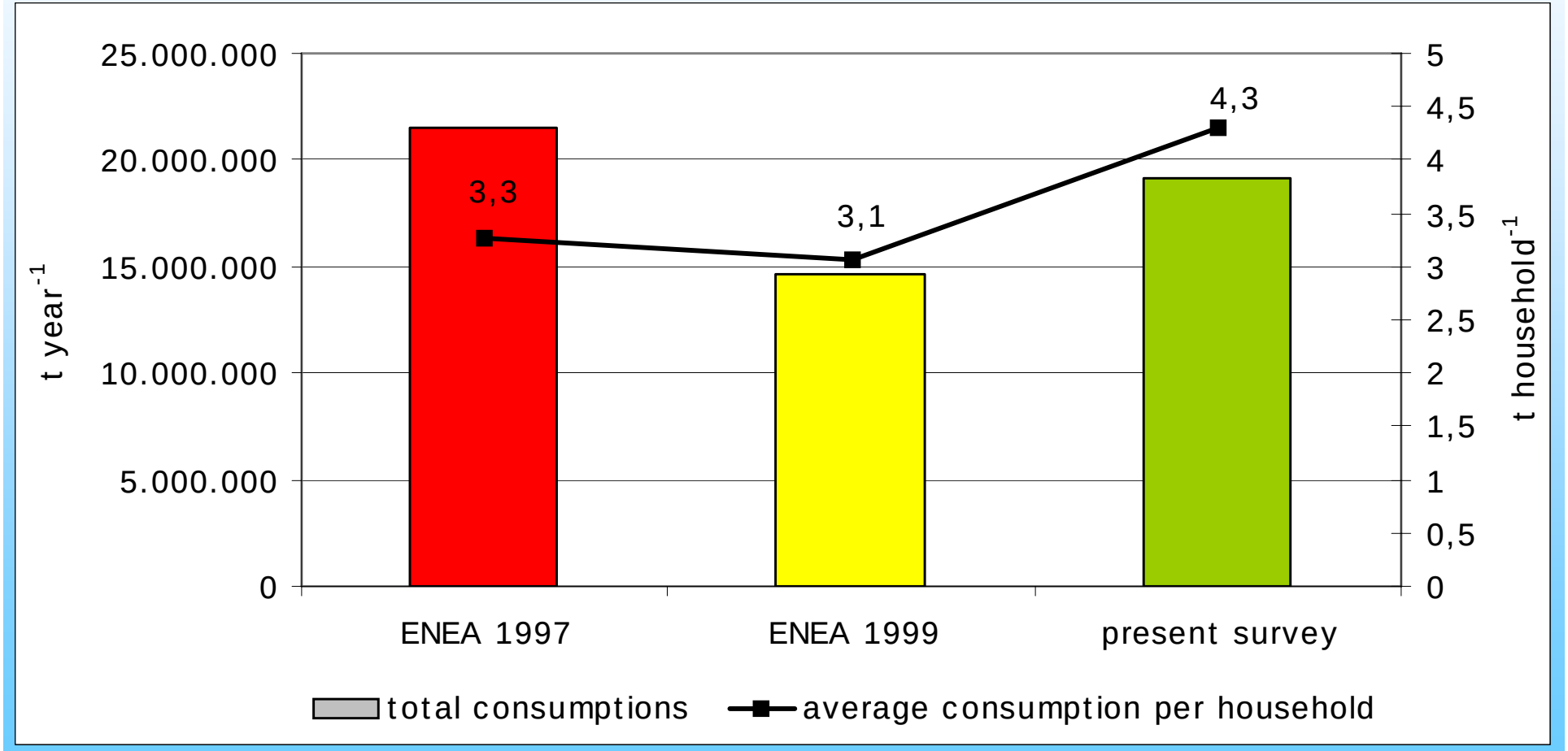
(17% - 30 % has considered probable the purchase)

The interest in the renewal of wood appliances is confirmed by information gathered from producers of the wood combustion system

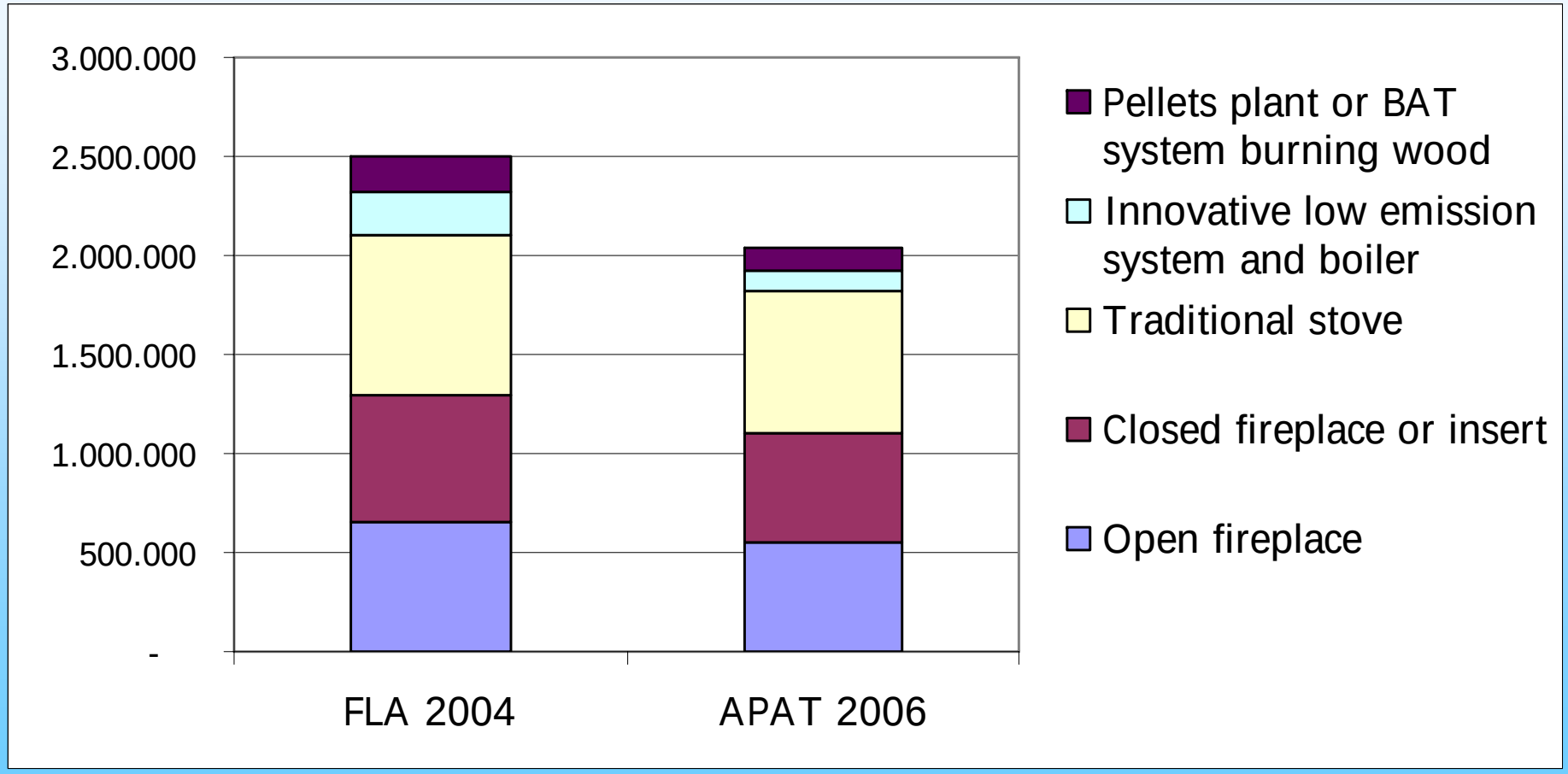


Increasing trend in sales for innovative devices from 53% to 77%

Wood consumptions in Italy (t/y)
Comparison with other surveys



Wood consumptions in Lombardy (t/y)
Comparison with other surveys



Emissions assessment
Emission factors in the household sector

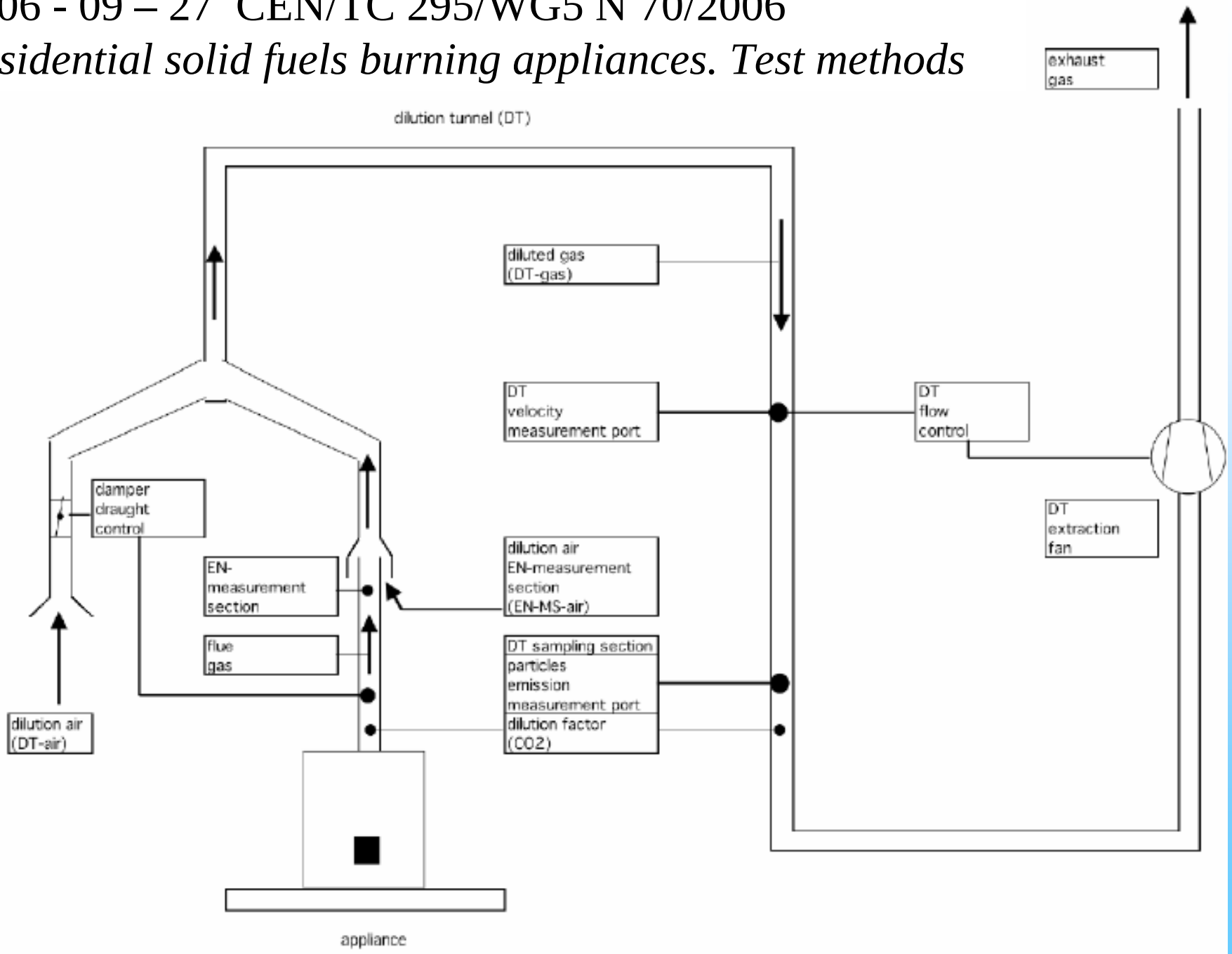
EF from a literature survey
(EEA Emission Inventory Guidebook + other sources)

	PM10 **g GJ^{-1}**	**NO_X** **g GJ^{-1}**	**NMVOC** **g GJ^{-1}**	**SO_2** **g GJ^{-1}**	**CO** **g GJ^{-1}**	**PAH** **mg GJ^{-1}**
Open fireplace	500	70	5,650	13	5,650	280
Traditional oven, closed fireplace or insert	250	70	1,130	13	5,650	280
Innovative low emission system and boiler	150	60	560	13	2,260	280
Pellets plant or BAT system burning wood	50	65	85	13	800	0.2
Natural gas	0.2	50	5.0	0.5	25	n.a.
Gas oil	5.0	50	3.0	100	20	75
Fuel oil	40	150	10	150	16	75

EF from natural gas and gas oil are much lower than
EF from wood burning

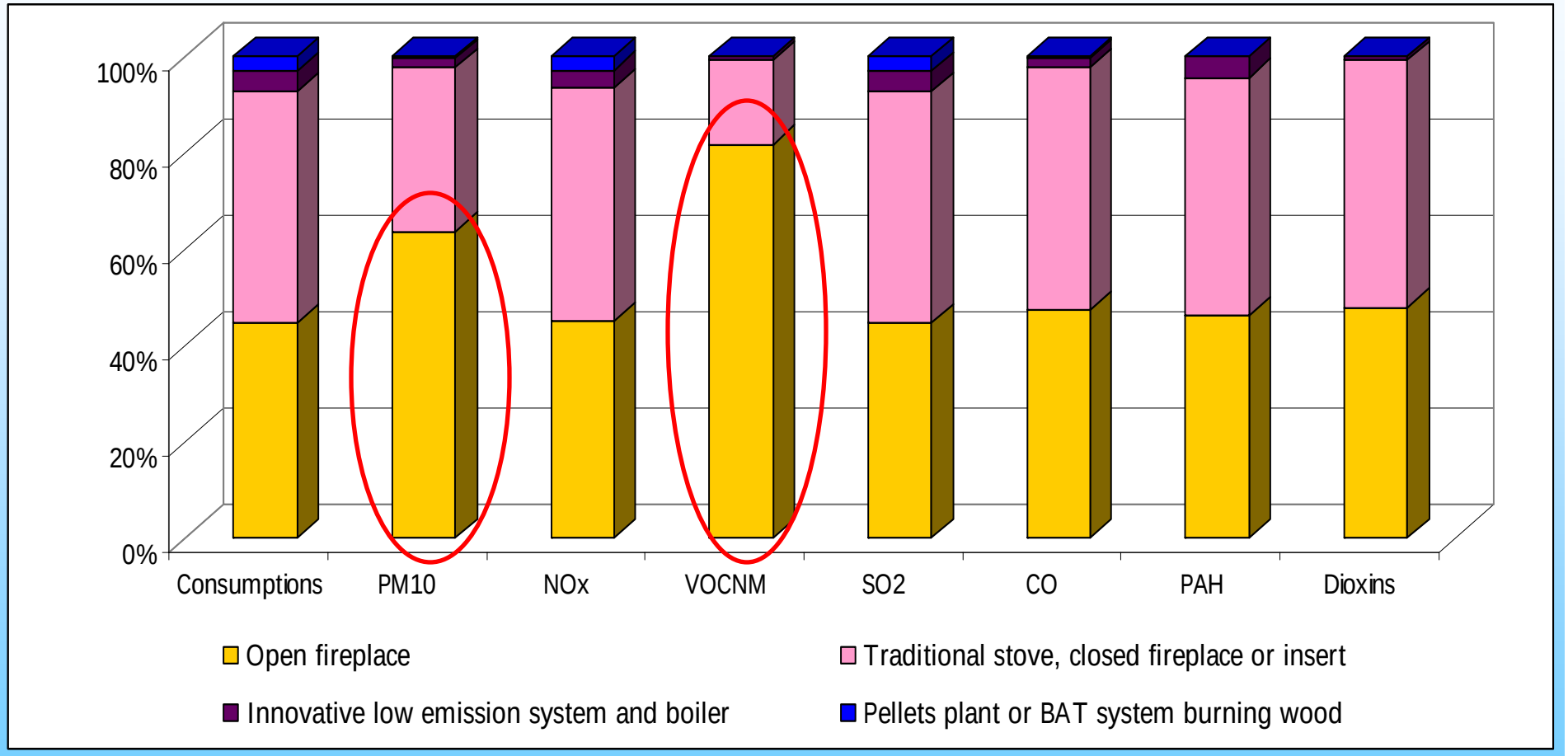
2006 - 09 – 27 CEN/TC 295/WG5 N 70/2006

Residential solid fuels burning appliances. Test methods



Emissions from household wood burning

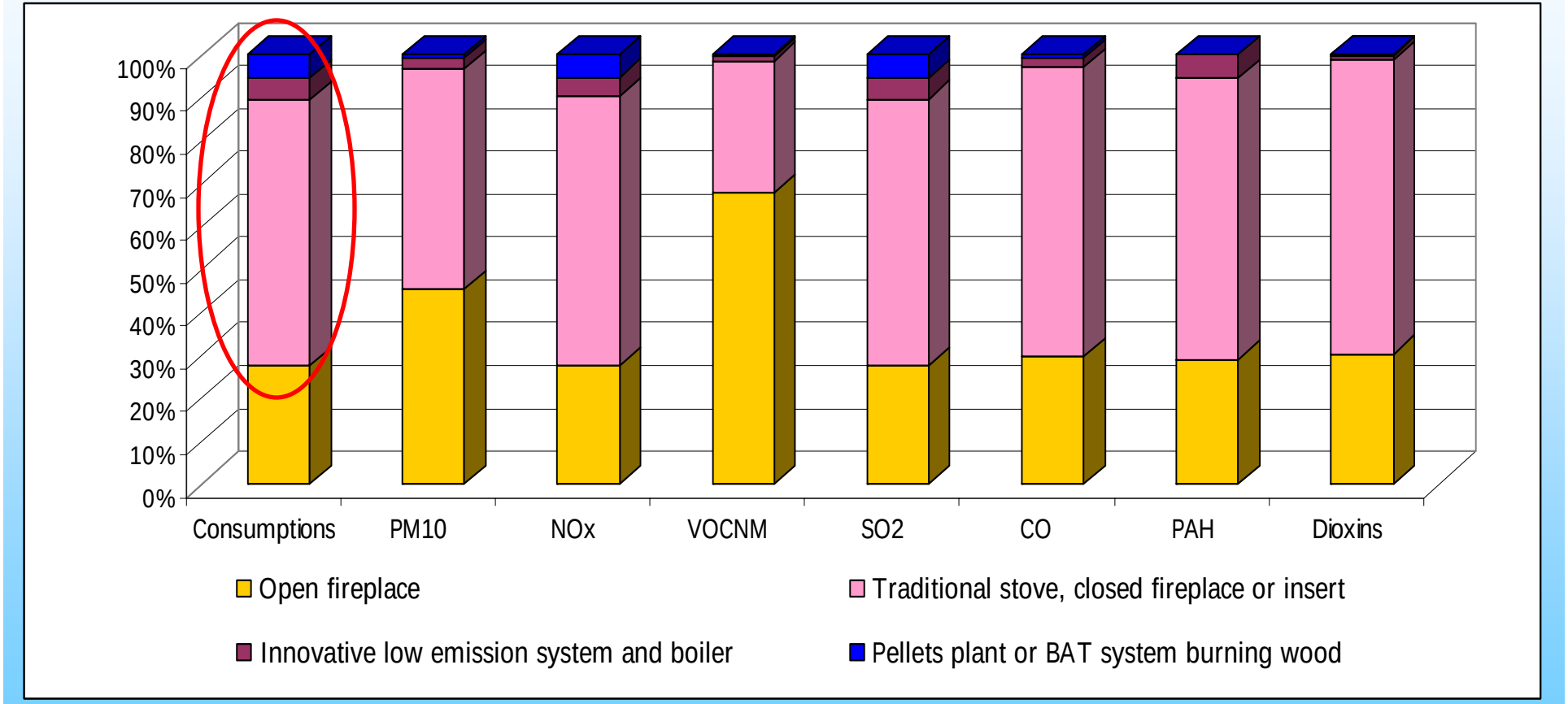
Italy



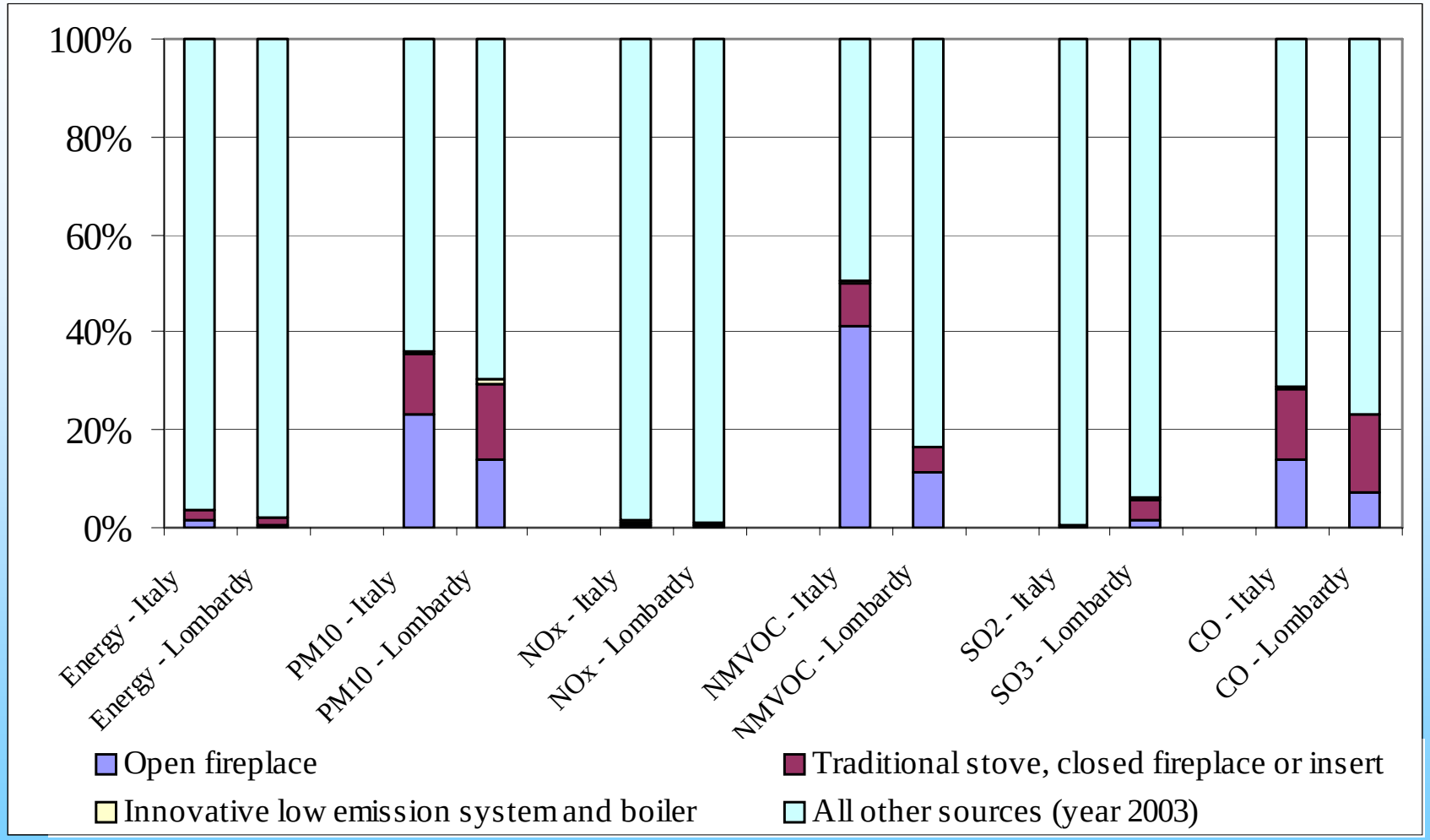
40% of wood (fireplaces) is responsible for almost 60% of PM10 emissions and 80% of NMVOC emissions

Emissions from household wood burning

Lombardy



Wood burning share on total 2003 emissions



CO_2 savings from the wood consumptions in domestic heating:
$\cong$ 2% of CO_2 emitted in Italy

Conclusions 1/2

Statistical analysis of data collected from 5,000 families has provided a better knowledge of Italian wood consumption for domestic heating.

Results of the present research are comparable with previous surveys, and provide useful details on used types of combustion installations and regional split of wood use.

Traditional wood systems (open fireplace, traditional stove) are widespread on the national territory as they represent more than 70% of the total, but trend in sales of innovative devices is growing.

Conclusions 2/2

- Information on the use of different appliances is of great importance, as PM and toxic emissions are directly linked to combustion technologies and are higher for old stoves and fireplaces.
- CO_2 savings due to the photosynthetic origin of wood are far lower than PM, VOC and PAH increase due to wood combustion.
- Innovative devices could lower emissions if older appliances are changed out.
- PM, VOC and PAH emission factor for innovative device burning wood are much higher than EF for traditional natural gas devices: the shift from natural gas to wood in the residential sector could be dangerous for air quality.


Thank You