



Abatement of emissions from small combustion installations, fuelled with solid fuels

dust and associated pollutants

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- Introduction
- Sources of emission
- Coal combustion process overview
- How to improve boilers construction
- Conclusions



1/5 Introduction

We all have the right to breathe a clean air

Curernt situation is bad



www.nowiny.gliwice.pl



fol. p.Paweł

www.24gliwice.pl

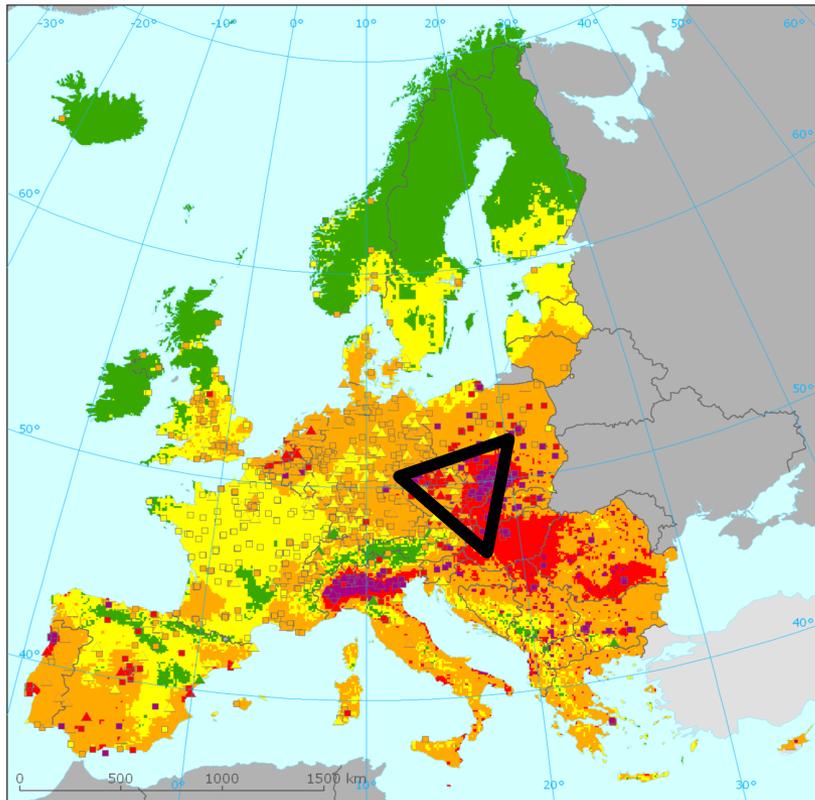
Diagnosis – air quality



www.powietrze.malopolska.pl

- Ambient air concentrations are monitored
- Exceedances of limit values – observed and measured ($\text{mg}/\text{m}^3_{\text{n}}$), suggested WHO limit values as low as 20 ($\text{mg}/\text{m}^3_{\text{n}}$)

Diagnosis – air quality



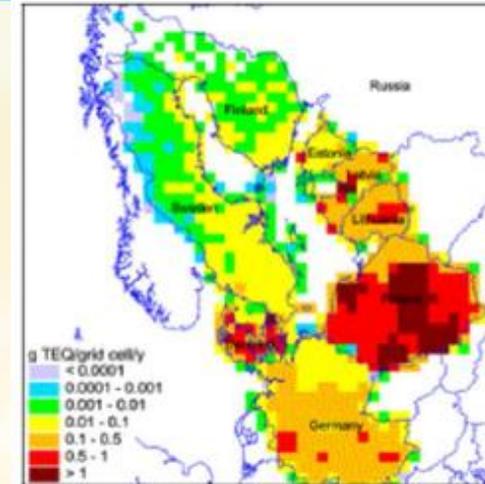
Particulate matter (PM₁₀)
36th highest daily value

Reference year: 2005
Combined rural and urban map

- < 20 µg m⁻³
- 20–30 µg m⁻³
- 30–50 µg m⁻³
- 50–65 µg m⁻³ > LV
- > 65 µg m⁻³
- Non-mapped countries
- Poor data coverage
- △ Rural background station
- Urban background station

http://www.eea.europa.eu/publications/spatial-assessment-of-pm10-and-ozone-concentrations-in-europe-2005-1/at_download/file

www.eea.europa.eu/



www.eea.europa.eu/

Hot-spots:

- Poland Krakow, Silesia,
- Czech Republic; Moravia-Silesia, Usti, Olomouc, Zlin, Brno, and Central Bohemia
- Slovakia; Zilina, Kraj Zilinsky, Bratislava
- Italy: Po valey

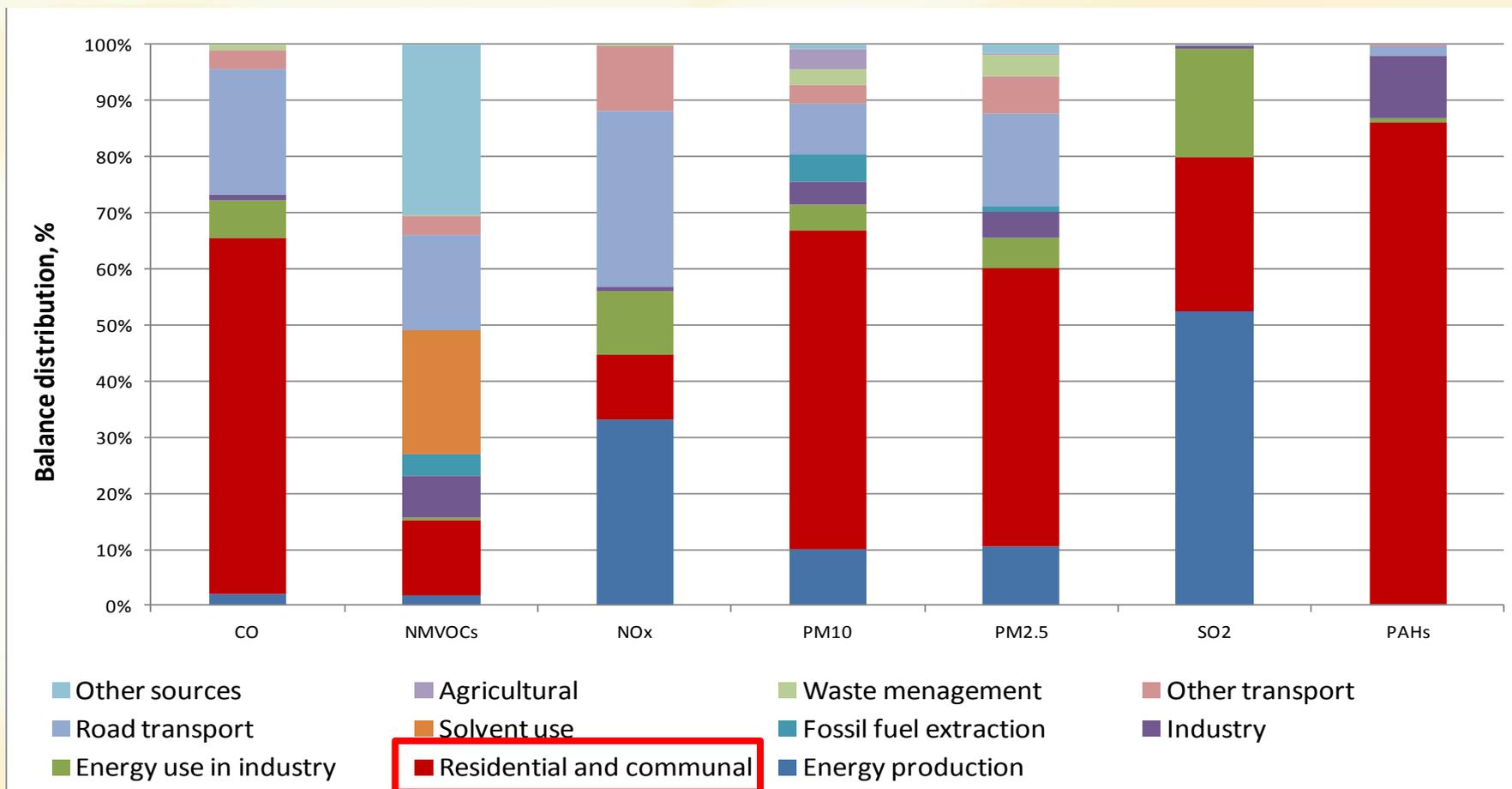


2/5 Sources of emission



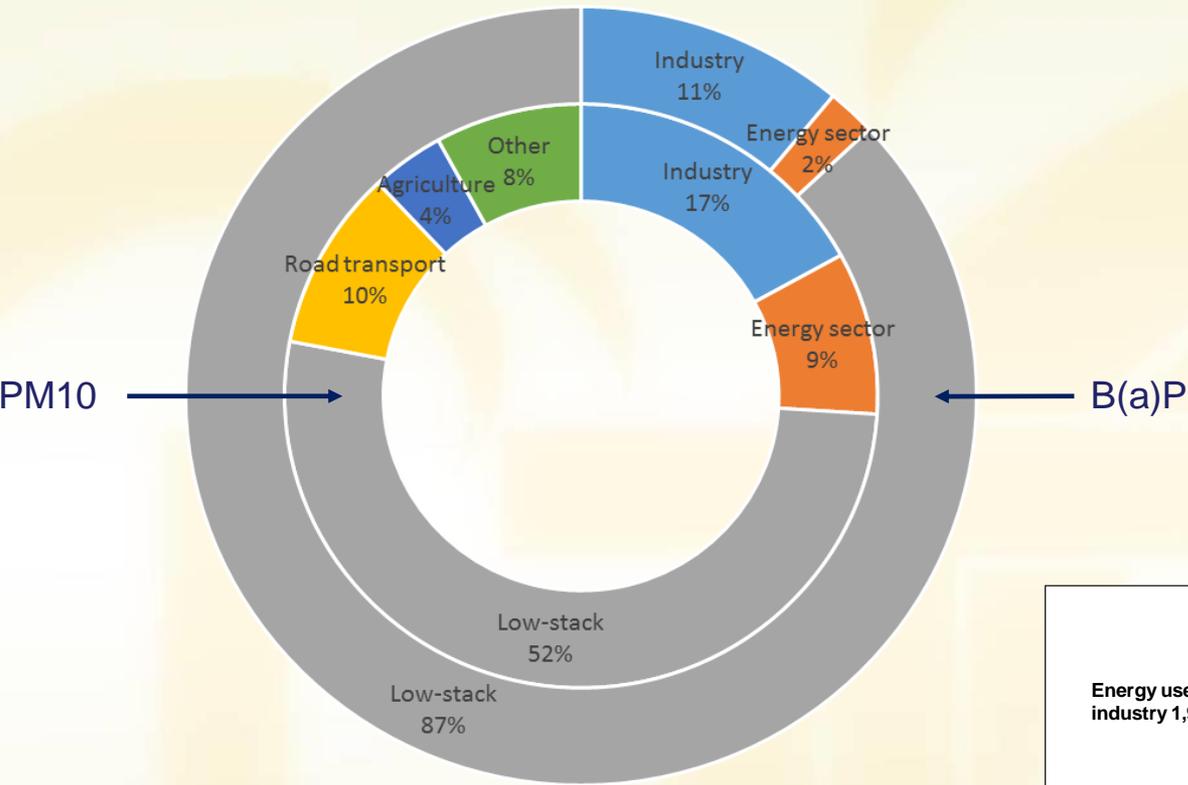
Diagnosis – major sources of emission

- Residential sector has highest significance

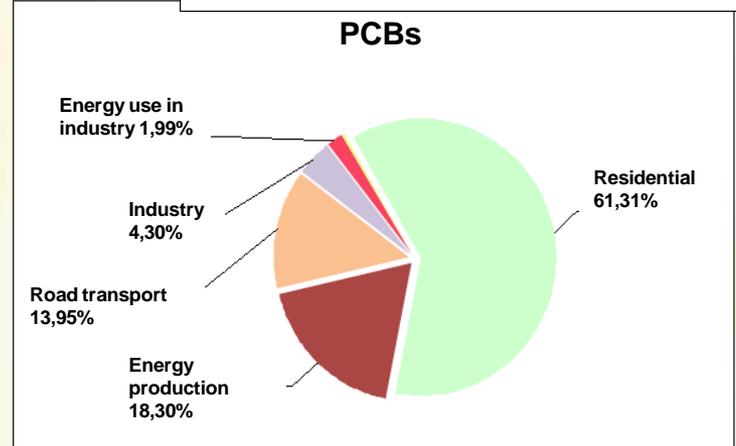
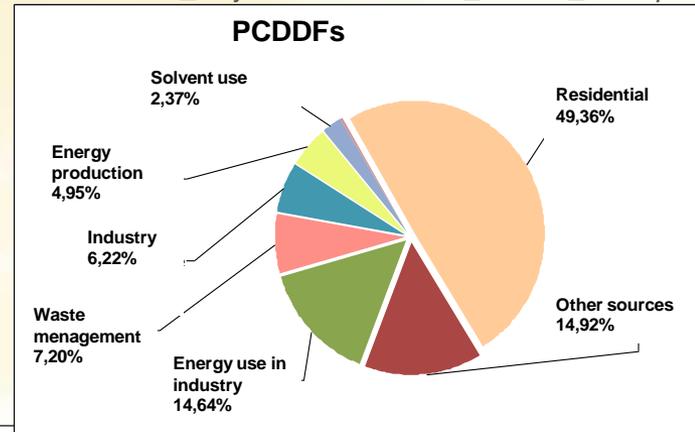




Diagnosis – major sources of emission



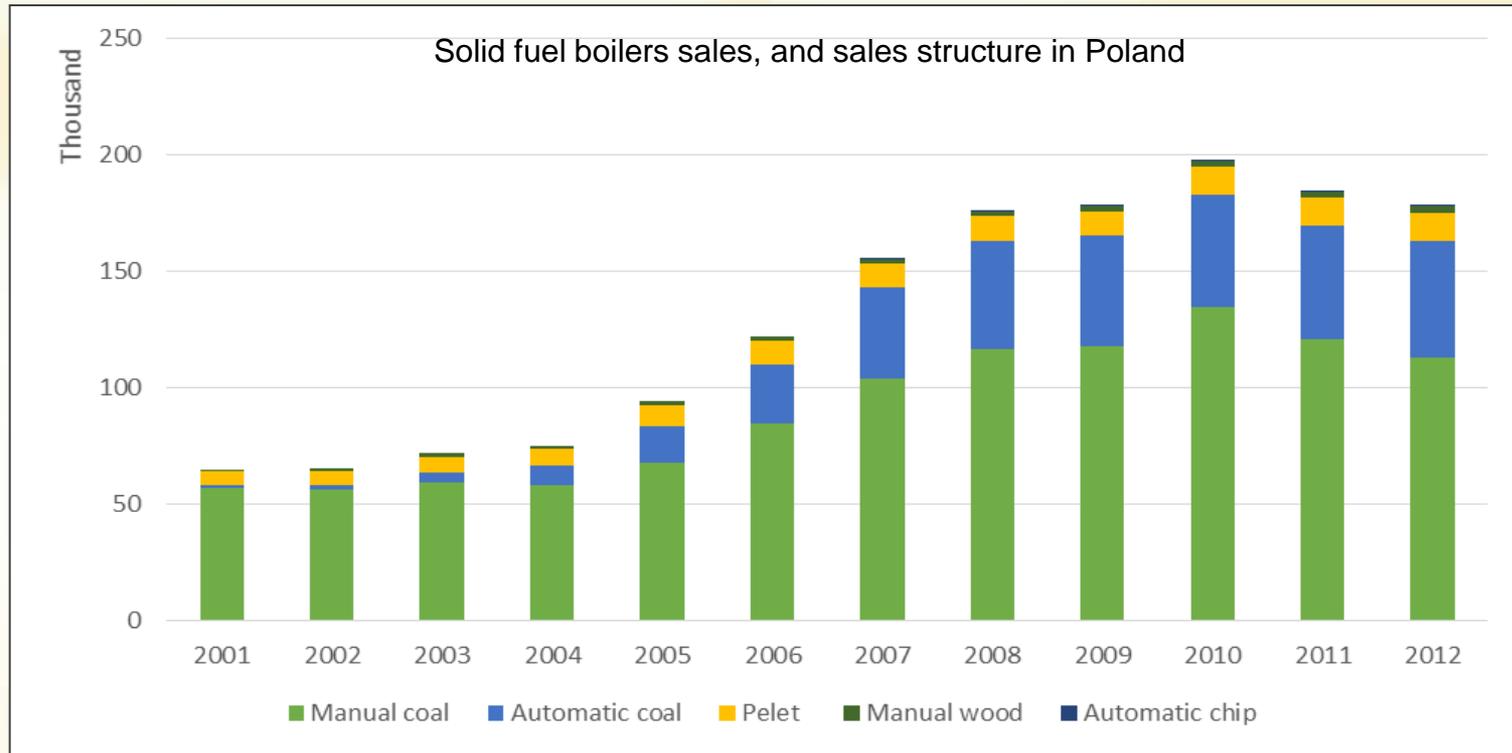
Source: K.Kubica
http://www.kobize.pl/materialy/Inwentaryzacje_krajowe/2013/IIR%20_Poland_2013.pdf



Source: based on KOBIZE, National Centre for Emission Balancing and Management
<http://www.iee.org.pl/>



Diagnosis – major sources of emission



>50% outdated, inefficient, „smokers” (manually fuelled)

Significant improvement potential!



3/5 Coal combustion process

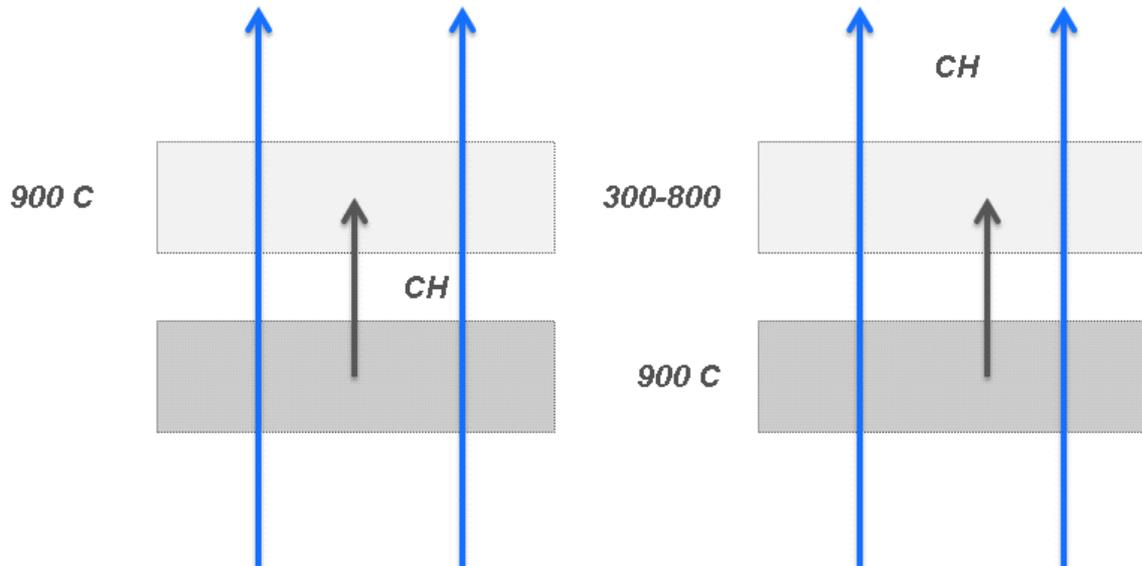
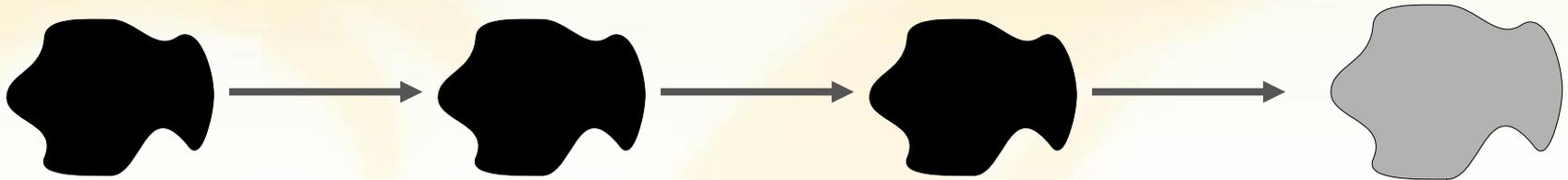


Solid fuel combustion

H₂O

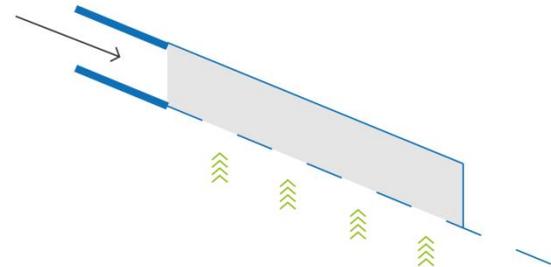
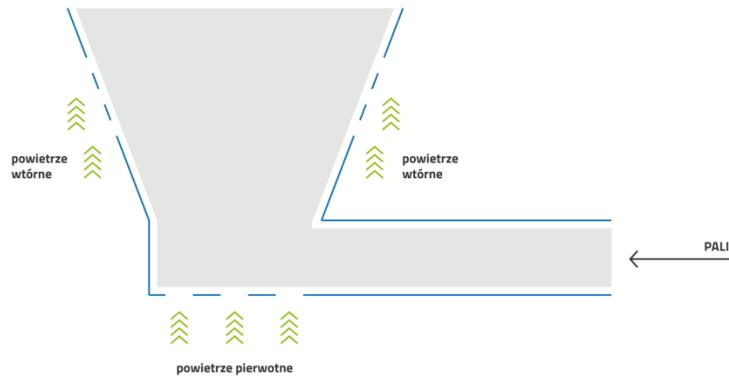
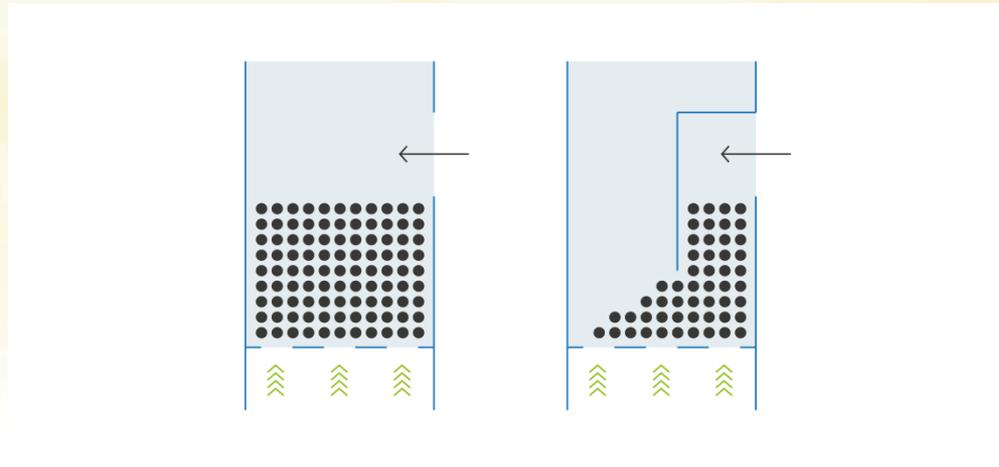
VOC, SO₂, CH, CO₂

CO₂, CO

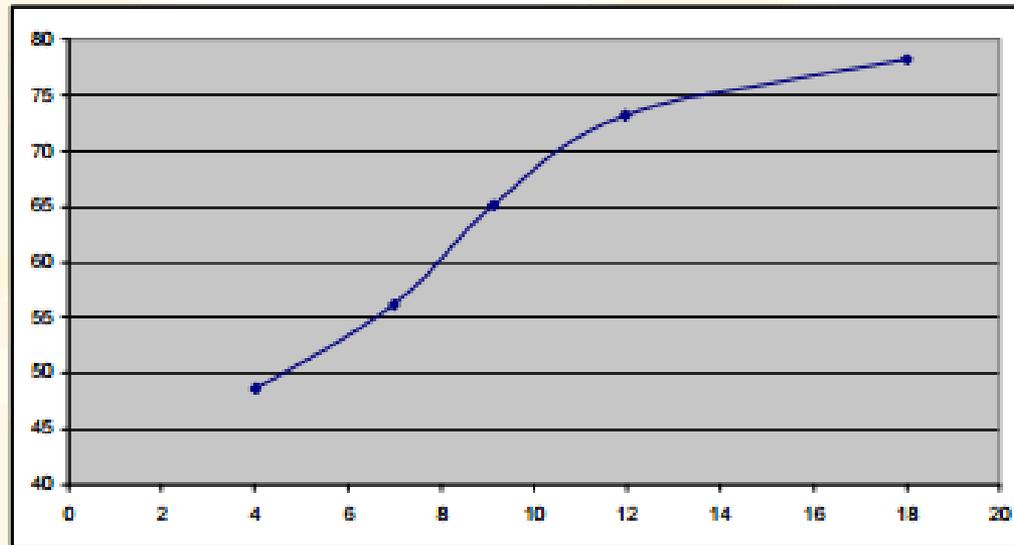
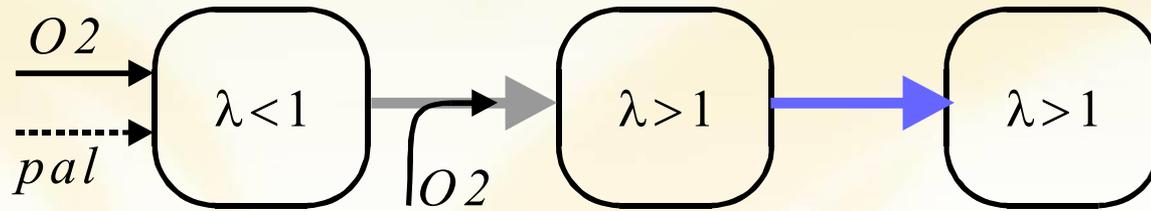




Typical organization of combustion



How combustion should be organized

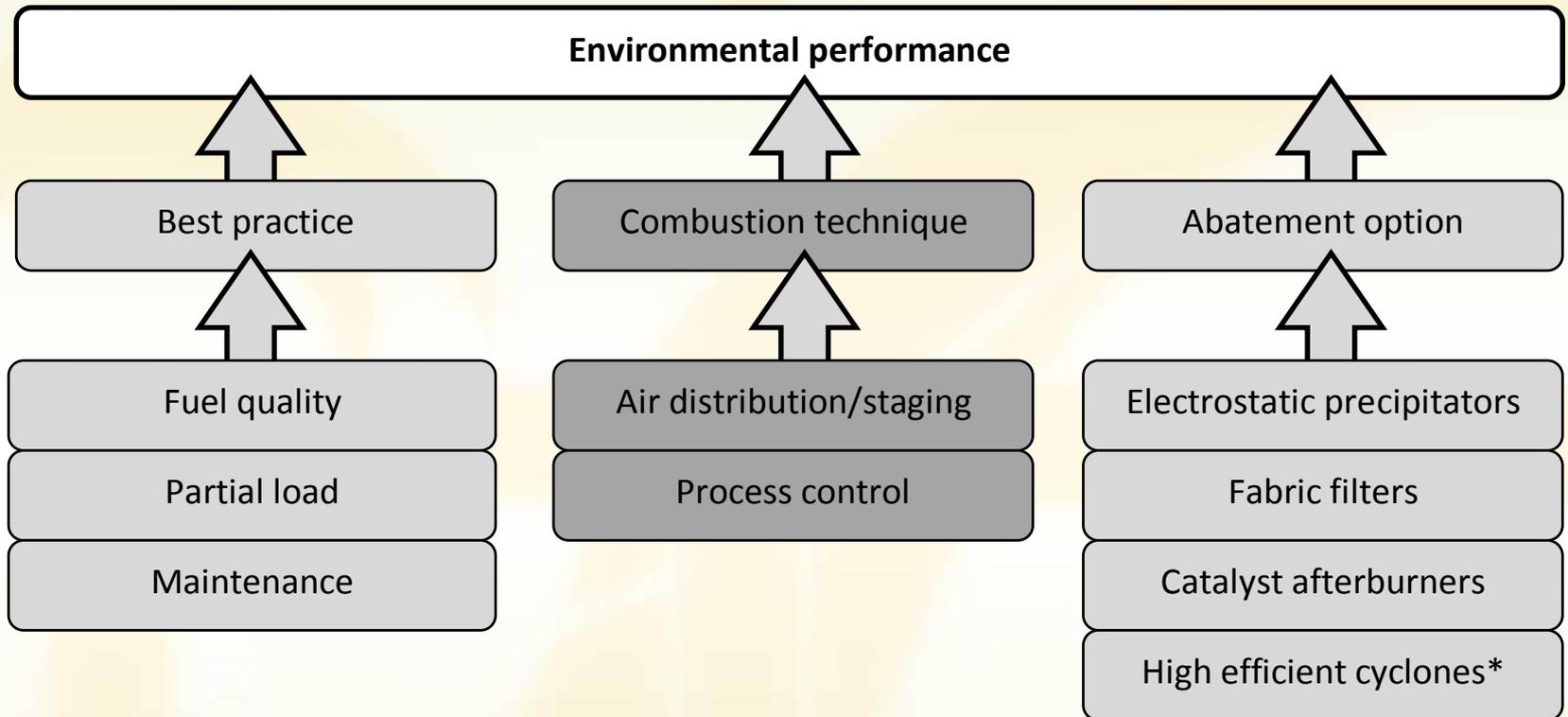




4/5 How to improve boilers



Emission abatement measures



- How to tackle/**solve** the **problem** of PM emission

Measures – fuel quality



<http://gazetacodzienna.pl/node/97866>

LHV, MJ/kg	10
Grain size, mm	0-1
Ash, %	30
Moisture, %	40

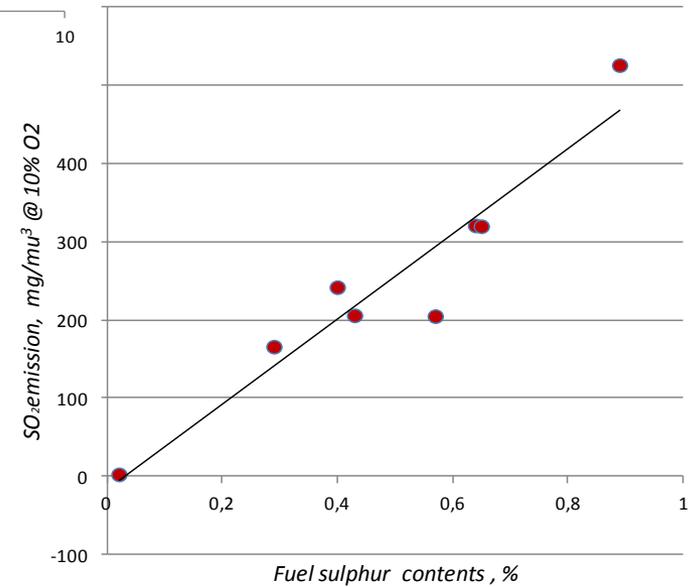
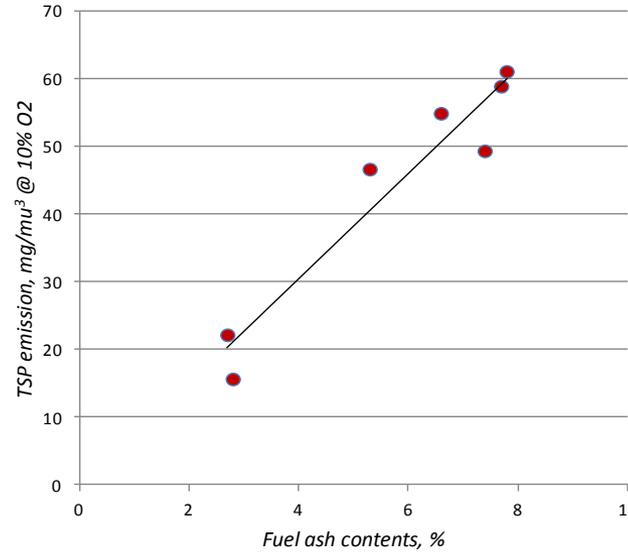
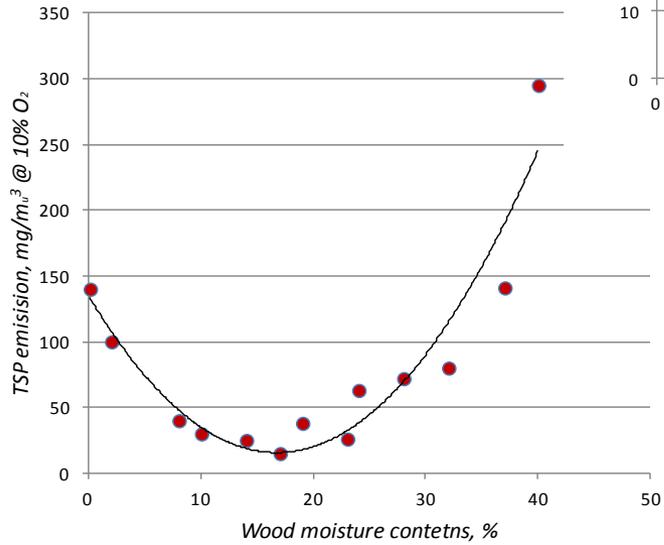


<http://www.kapost.pl/oferta/wegiel/wegiel-tauron-wydobycie/ekogroszek-jaret/>

28
5-25
6
10



Measures – fuel quality



Source: Hans Hartmann Technology and Support
Centre of Renewable Raw Materials (TFZ) ,

Primary measures – limiting cause not the outcomes

Advantages – *cost effectiveness*



**smoker
(manually fuelled)**

<http://czysteogrzewanie.pl/kociol/elektryczny-kijek-zamiast-siekierki/>

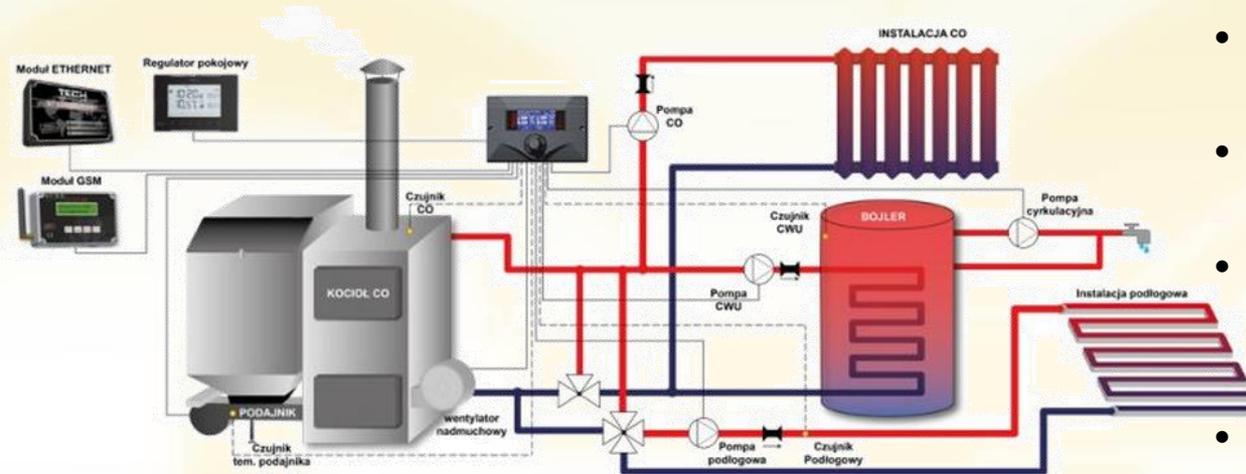


**automatic coal
boiler BAT**

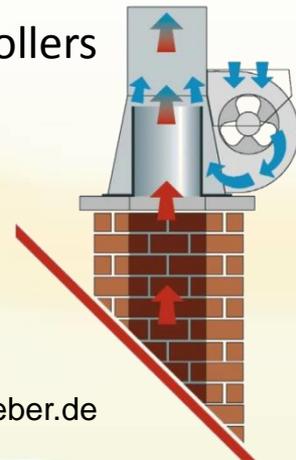
<https://foxhurt.pl/kociol-5-klasy-z-podajnikiem-defro-sigma-24kw-do-290-m2>

Application of an advanced control system

- O₂ probes, Lambda control
- CO probes
- Flue temperature control
- Room and ambient air temperature control
- PID controllers
- Fuzzy logic controllers
- Draft control

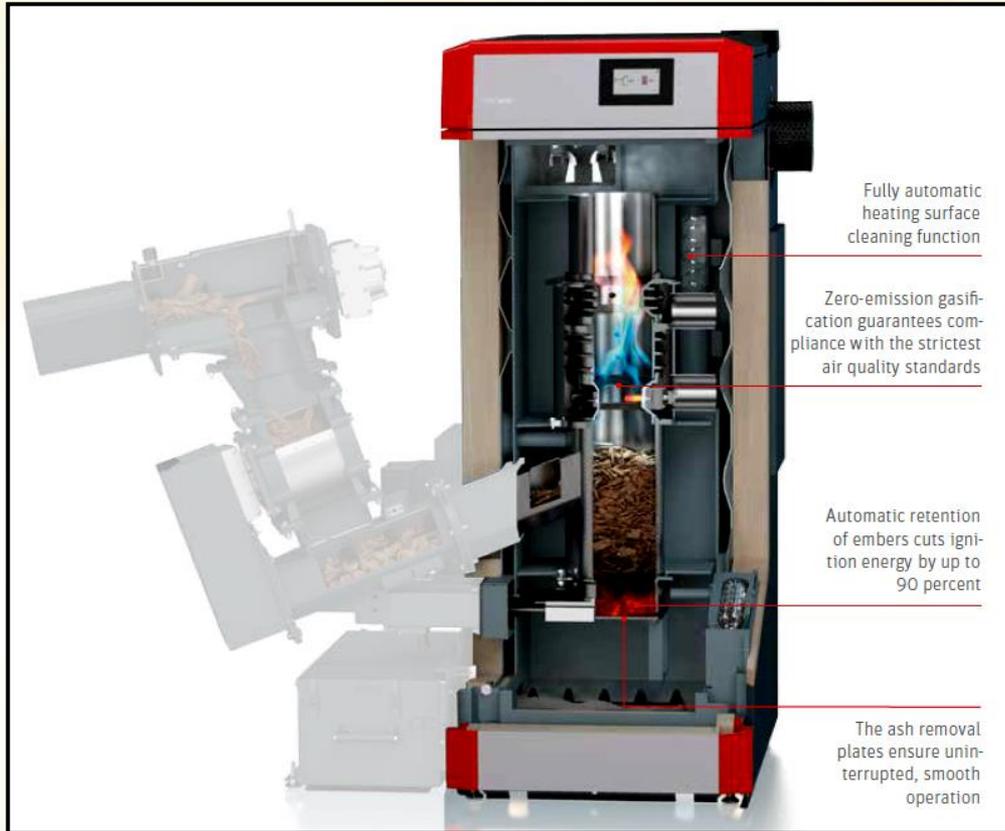


www.kotlomania.wordpress.com





Measures – ultra-low emission appliances



- Almost „zero emission” emerging technologies (*triple combustion chamber, fuel gasification*)
- Improvement potential **Best Available Techniques (BAT)** - PuroWIN,

Source: WINDHAGER,

http://www.windhager.com/int_en/

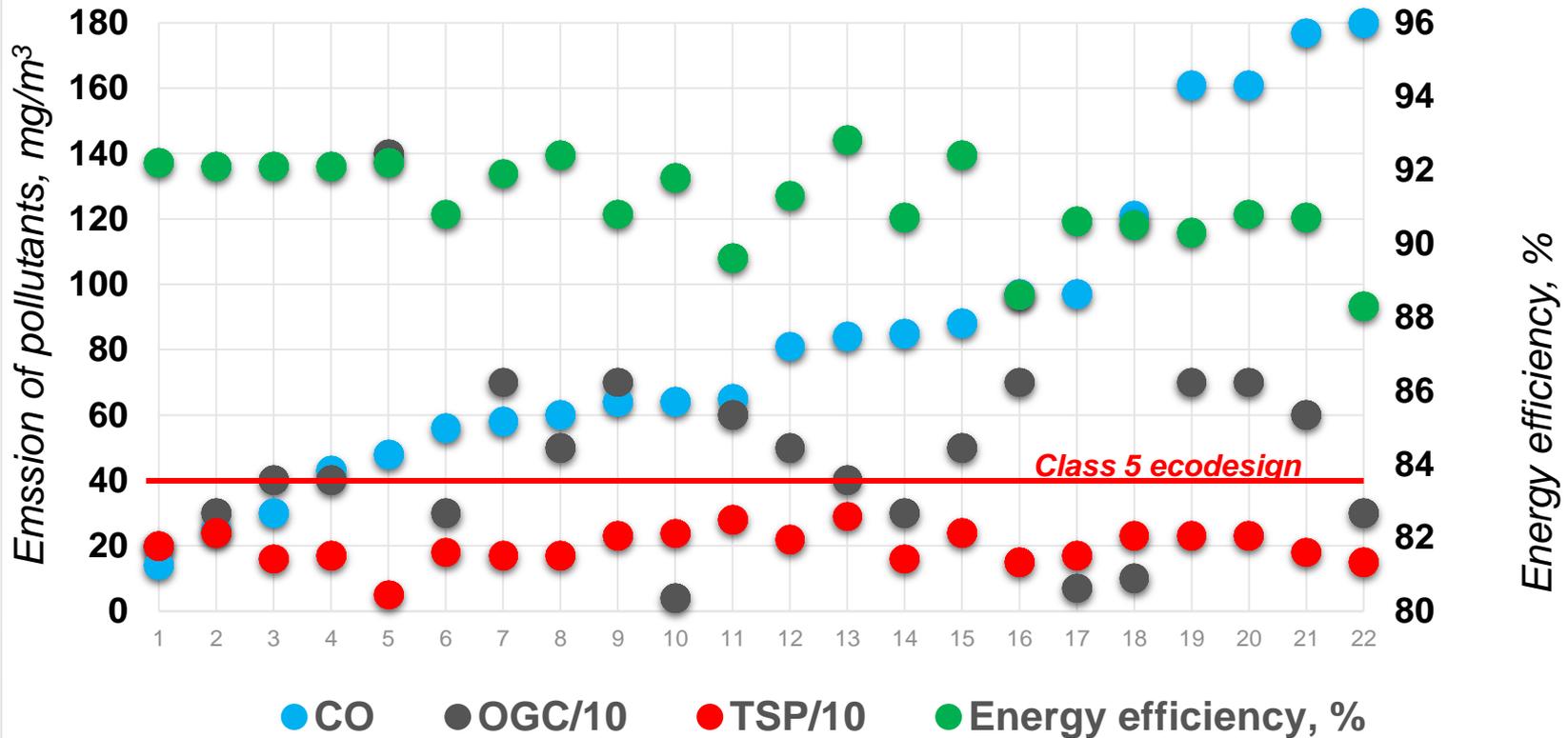




Measures – BAT applainces

Imprvement potential Best Available Techniques (BAT)

Top 10, automatic *coal boilers*

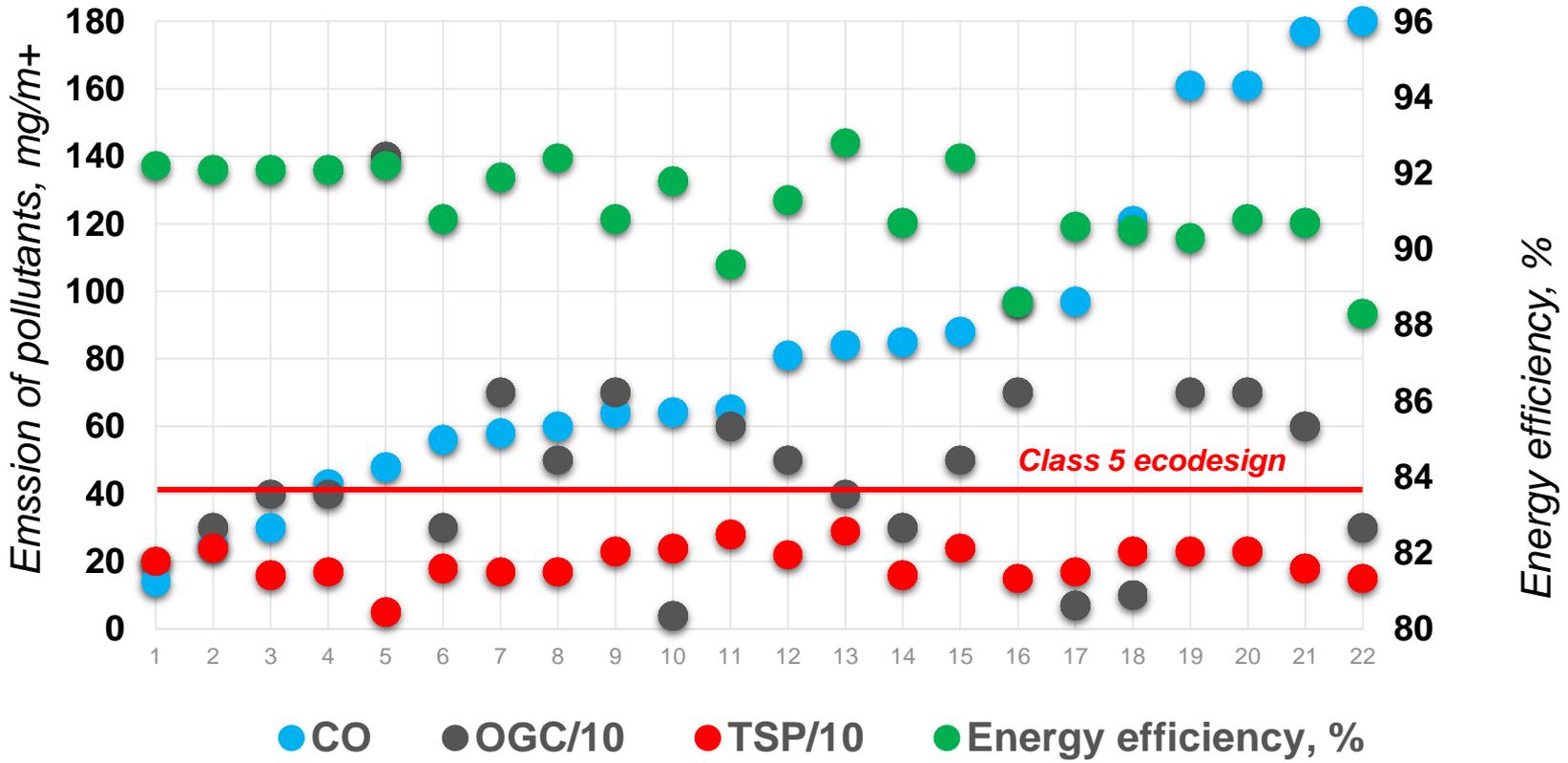




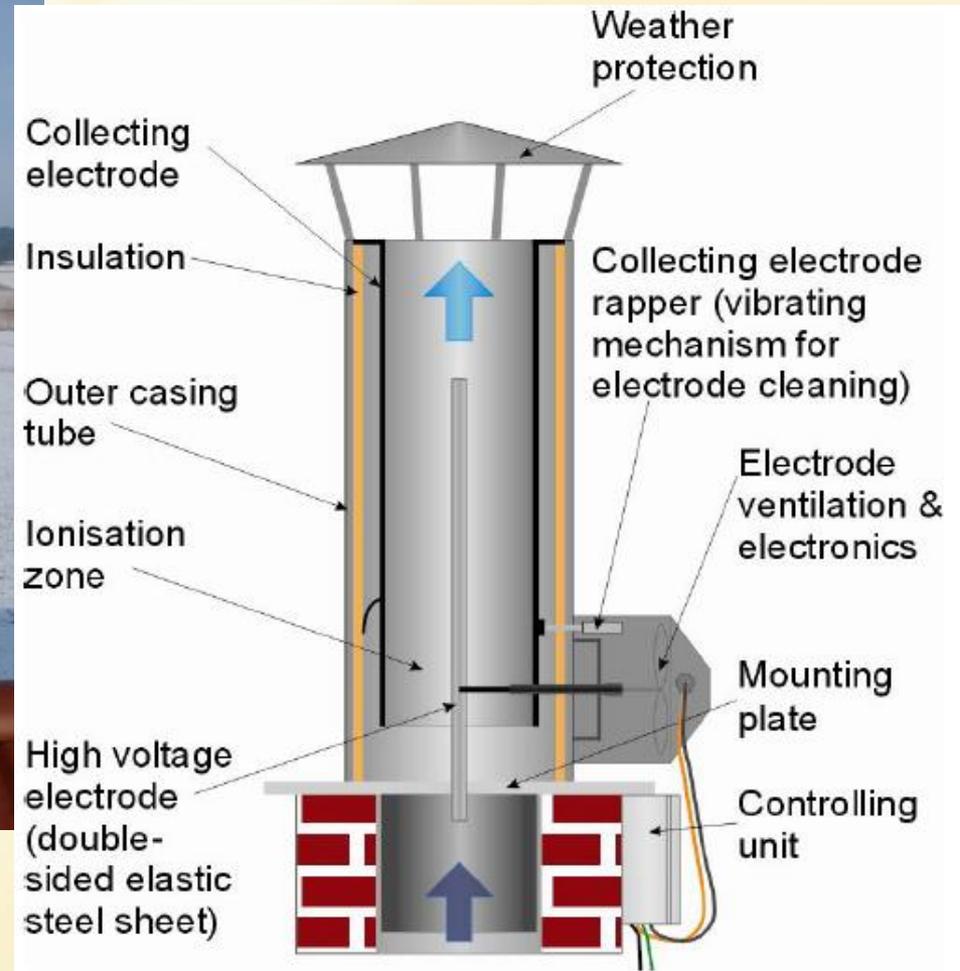
Measures – BAT applinaces

Imprvement potential **Best Available Techniques (BAT)**

Top 10, automatic *biogenic fuel boilers*



Secondary measures – flue cleaning





Secondary measures – flue cleaning

The ElectroStatic Precipitator **ESP** technology

- Average **total dust precipitation efficiencies** of **50 to 90%** can be achieved. The particle precipitation efficiency strongly depends on the fuel used and the combustion technology (old/new system).
- PM concentration in the flue gases **<<20 mg/m³**
- When combined with Class 5 appliance **4-8 mg/m³**
- Low electricity consumption **~20Wh** in operation mode
<1Wh in stand-by mode
- Automatic deashing, limiting maintenance
- Unit price ranging between 2000-3000 PLN (500-800 Euro/piece)
- Possible retrofitting





Summary

- The Best Available Techniques of combustion installation below 500kW (**BATs**), commercially available, **guarantee** performance at the **lowest required ELVs** relevant for **dust** emission.
- The use of **certified fuels** is required – appropriate quality of coal and biomass.
- Reaching the lowest **ELVs** by **non BATs** new appliances, and **existing systems** requires secondary abatement measures – **dedusting apparatus**.
- **Highest performance** is delivered by **fabric filters** and **electrostatic precipitators**, however the latest offer **ease of use** and **maintenance** as well as **low operating costs**.
- It is not difficult to built low emission boiler, it is challenge to built it cheap enough.



5/5 Conclusions



Tahnk you for your attention



Źródło: http://album.sarata.pl/2007-12%20Zakopane/slides/IMG_0612.html