



Project ERANET “Future BioTec”  
Workshop: “Technologies for clean biomass combustion”

## Low emission operation manual for chimney stoves

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im Kompetenzzentrum für Nachwachsende Rohstoffe



## Intention of the manual



- **The manual wants to:**
- highlight the user specific chances to avoid emissions and heat losses
- prevent hazardous combustion performances of chimney stoves
- support end users in the operation of their stove
- provide guidance for manufacturers when drafting their stove specific manuals



## Definition chimney stoves

- free standing room heater (not walled, with a front window)
- relatively low heat storage
- single-layer fuel charging
- frequent recharging required





# How was the information collected?

## **Literature review**

(performed by the partners from AT, SE, FI and GE). Regarded sources are:

- General handbooks on stoves
- Flyers for stove operation
- Stove specific operation manuals
- Chimney sweep advisory and teaching information
- Scientific research reports

## **Dedicated combustion trials on stove operation**

- Combustion trials with stoves on test bench concerning loading procedure, fuel type impact, moisture content, log size, charging time, etc.

## **Project workshops**

- Common discussion of recommendations and scientific findings



# Main content of the manual

- Wood as fuel
- Log wood drying, storage and quality control
- Stove technology
- Stove operation
  - ignition
  - heating operation
  - ash handling & stove maintenance
  - troubleshooting





# Ignition materials

## Kindling materials



thin wood sticks



coarse wood chips

- coniferous wood type preferred

## Ignition aids



wax-wood  
wool blocks



paraffin wood  
fibre sticks



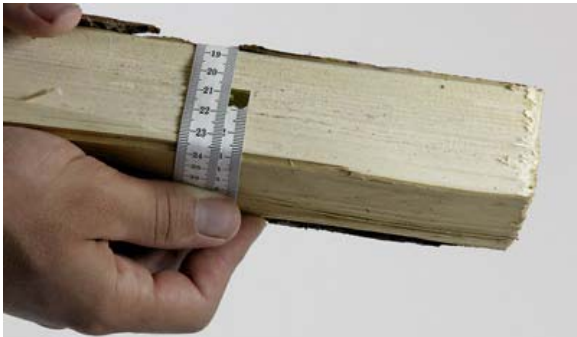
paraffin wood  
fibre blocks

- burning time: 5-7 min
- no paper or carton
- no liquids

# Fuel specification: Wood logs

## Fuel quality aspects explained:

- permissible fuels
- not suitable fuels
- moisture content aspects
- size, shape, etc.



## Equal energy contents

2.3 kg Softwood	2.4 kg Hardwood	2.1 kg Wood briquette	1.7 kg Brown coal briquette	1 litre Heating oil

## Log wood standard requirements (EN 14961-5)

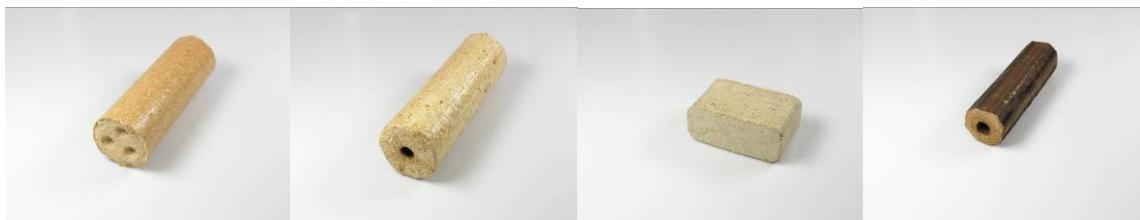
Property class	Unit	Grades		
		A1	A2	B
Origin and source		1.1.3 Stemwood 1.2.1 Chemically untreated wood residues	1.1.1 Whole trees without roots 1.1.3 Stemwood 1.1.4 Logging residues 1.2.1 Chemically untreated wood residues	1.1.1 Whole trees without roots 1.1.3 Stemwood 1.1.4 Logging residues
Wood species		To be stated		To be stated
Diameter, D <sup>a</sup>	cm	D2 ≤ 2 D5 2 ≤ D ≤ 5 D10 5 ≤ D ≤ 10 D15 10 ≤ D ≤ 15 D15+ > 15 (act. value to be stated)		D15 ≤ 15 D15+ ≥ 15 (actual value to be stated)
Length, L <sup>b</sup>	cm	L20 ≤ 20 L25 ≤ 25 L33 ≤ 33 L50 ≤ 50 L100 ≤ 100		L33 ≤ 33 L50 ≤ 50 L100 ≤ 100
Moisture, M <sup>c</sup>	%, wet basis	M20 ≤ 20 M25 ≤ 25		M25 ≤ 25 M35 ≤ 35
Volume or weight	m <sup>3</sup> stacked or m <sup>3</sup> loose or kg	To be stated which volume or weight is used when retailed		
Proportion of split volume	% of pieces	≥ 90 %	≥ 50 %	No requirements
The cut-off surface		Even and smooth	No requirements	No requirements

<sup>a</sup> 85 % of the firewood should be kept in specified diameter property class.  
<sup>b</sup> Length should be in the limits of ± 2 cm. It is allowed to have 15 % firewood shorter than requested length including the limit value.  
<sup>c</sup> Moisture content should not be less 12 w-% on wet basis (M)



# Fuel specification: Briquettes

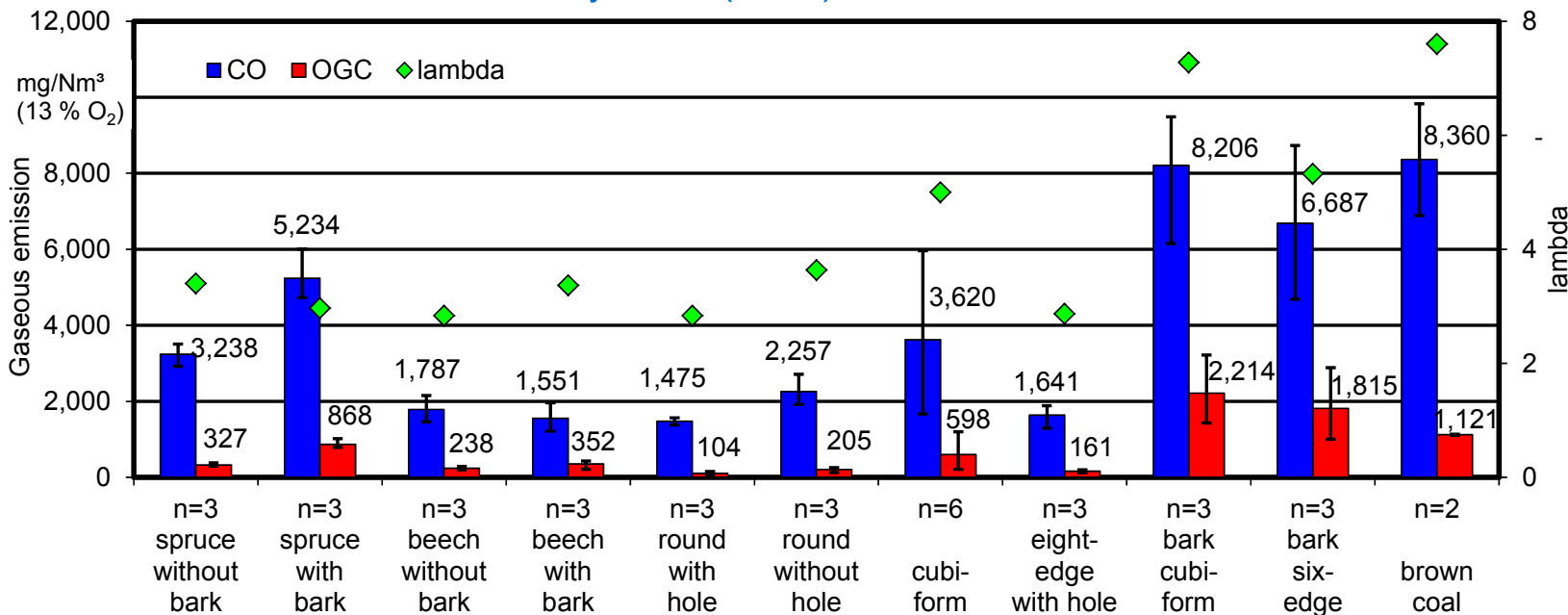
## Suitable wood briquettes



## Pure bark briquettes



## Fuel differences in chimney stove (8 kW)





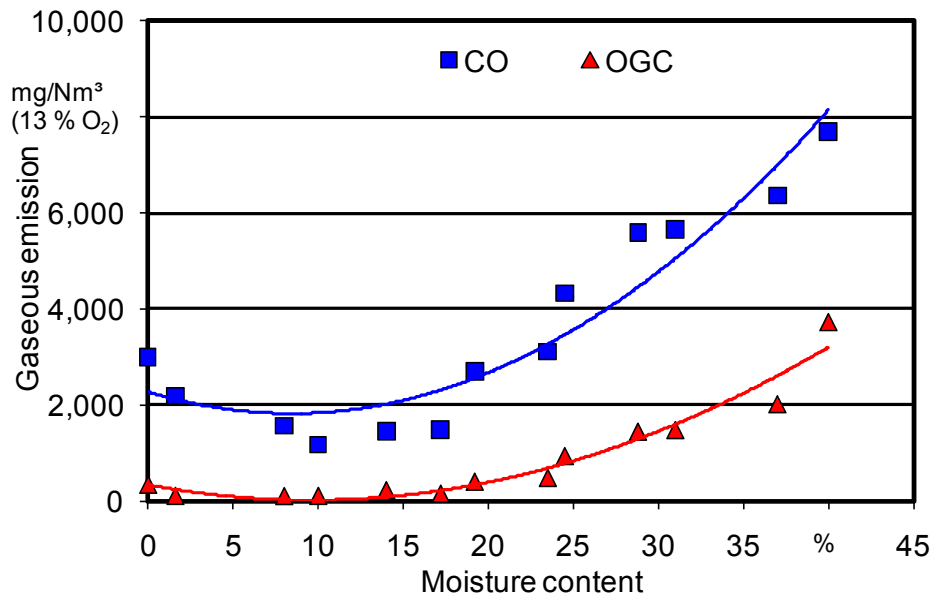
# Log wood storage and moisture content



## Moisture content requirements for stoves:

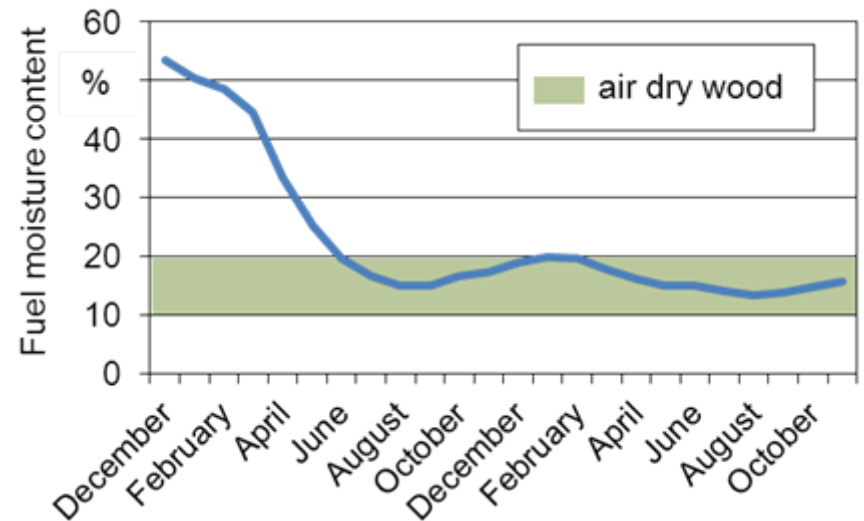
- maximum: 20 %
- minimum: 8 %
- natural wood drying requirement: minimum 1 year (full summer)
- careful with log wood from artificial drying

## Variable fuel moisture in chimney stove (8 kW)



## Typical drying progress of wood logs

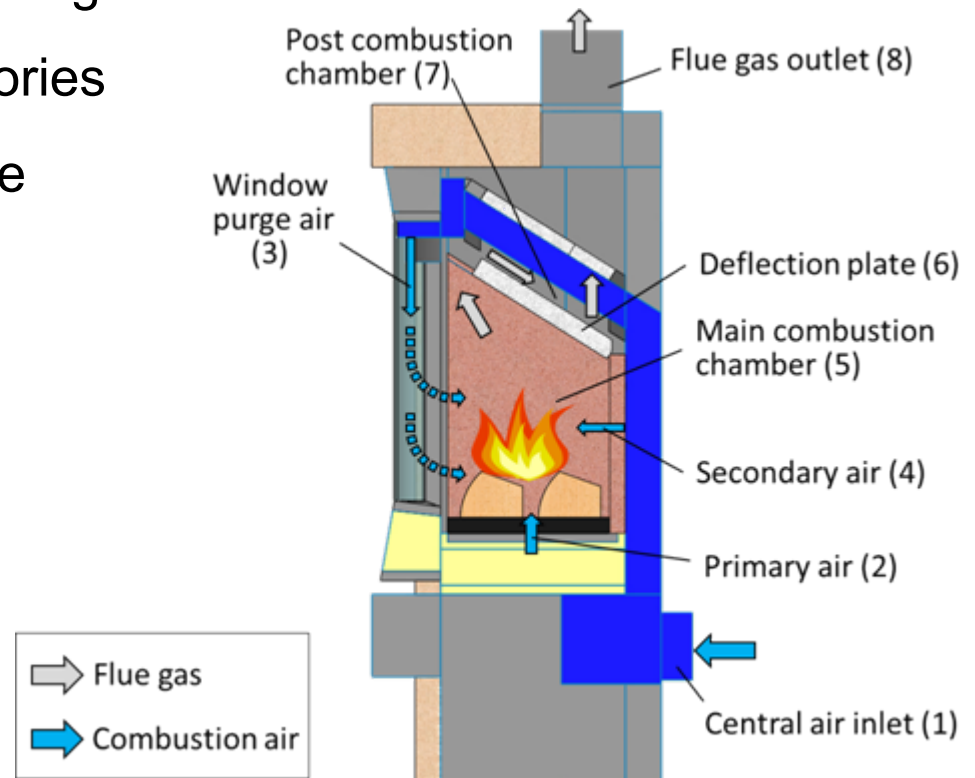
(Example here: 1 m logs, staked outdoor, Southern Germany)



# Stove functioning and stove selection

## Information given in the manual:

- Components and general functioning
- Retrofit components and accessories
- Criteria for choosing a good stove
- Selection of proper stove power





# Suitable stove heat power output

**Minimum required living space of rooms connected by a joint airspace and heated with the designated wood stove**  
*(for reference climate of Germany)*

Specific heat demand of the building	Nominal heat power output of stove		
	5 kW	7 kW	9 kW
<b>70 kWh/(m<sup>2</sup> a)</b> i. e. modern buildings according to the newest insulation standards	> 100 m <sup>2</sup>	> 100 m <sup>2</sup>	> 100 m <sup>2</sup>
<b>160 kWh/(m<sup>2</sup> a)</b> i. e. medium insulation standard*	50 m <sup>2</sup>	70 m <sup>2</sup>	90 m <sup>2</sup>
<b>300 kWh/(m<sup>2</sup> a)</b> i. e. older buildings with low insulation standard	30 m <sup>2</sup>	40 m <sup>2</sup>	50 m <sup>2</sup>

\* mean value of building stock in Germany



# Stove ignition: proposed procedure (top down method)

Starting the fire from the top: Ignition module

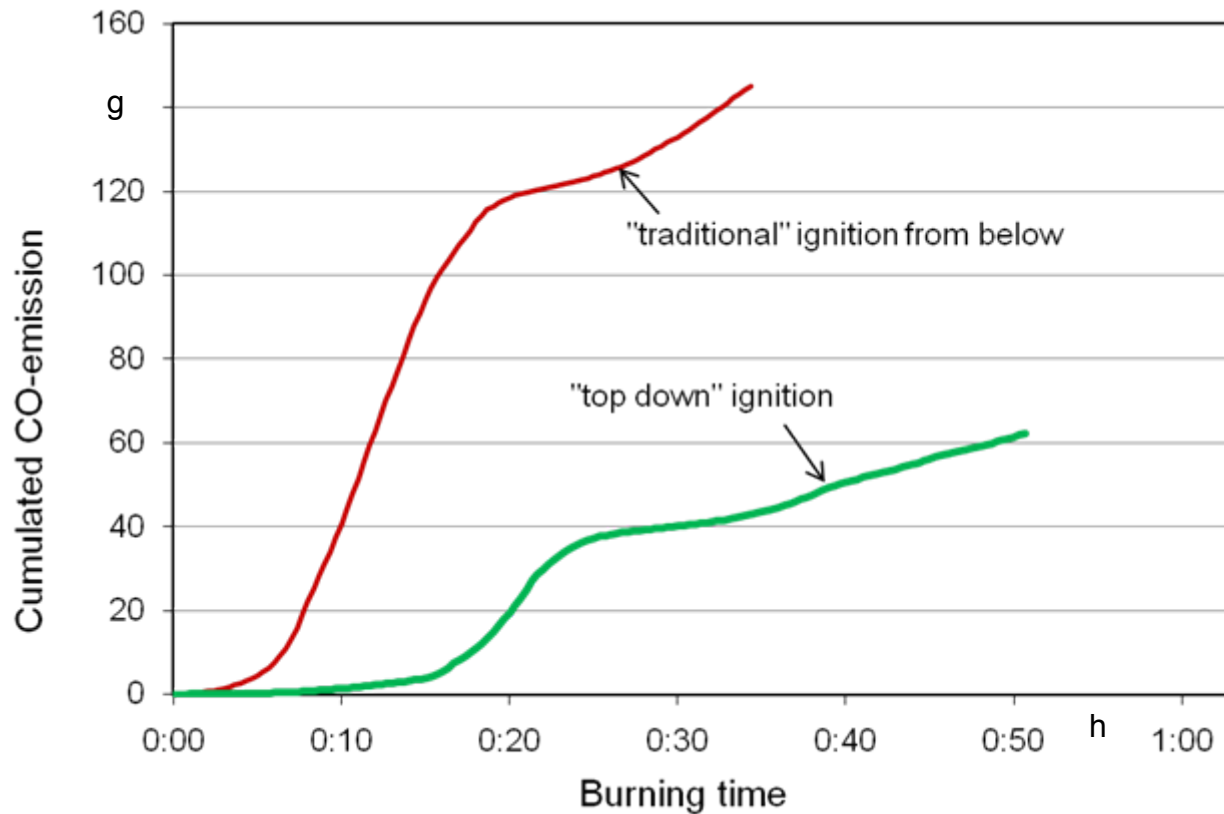


Top down ignition method





# Stove ignition: “top down” vs. “traditional” method



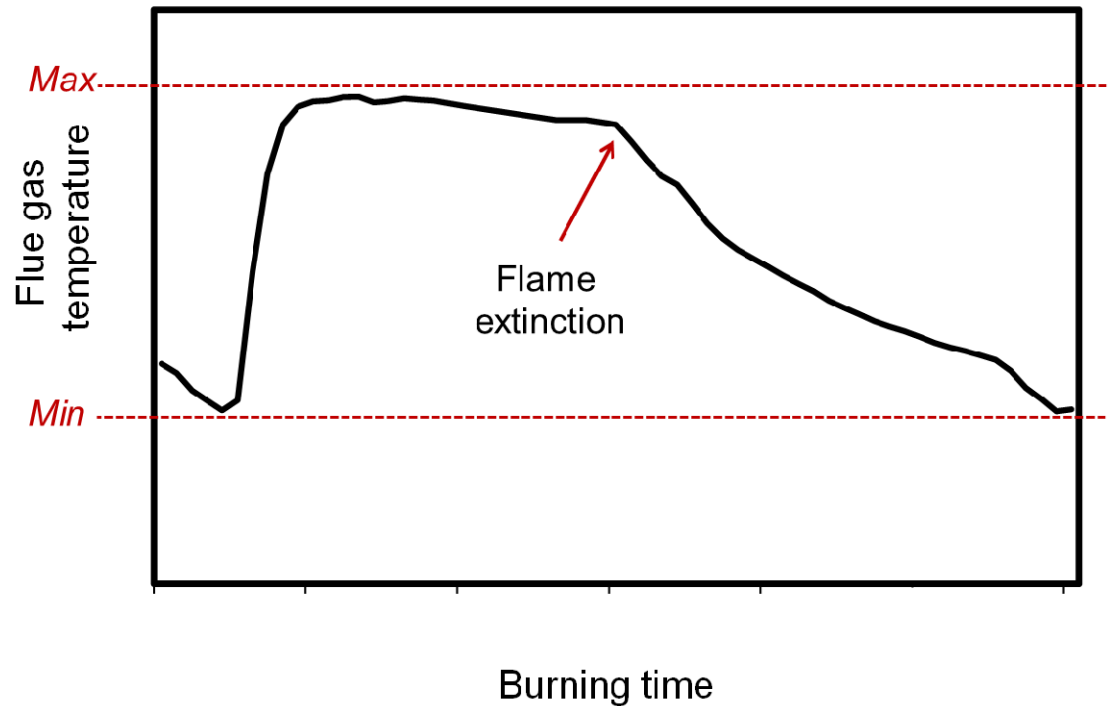
Trials performed with 8 kW chimney stove with grate,  
results are mean values of three replications, all were started from cold stage





# Recharging time

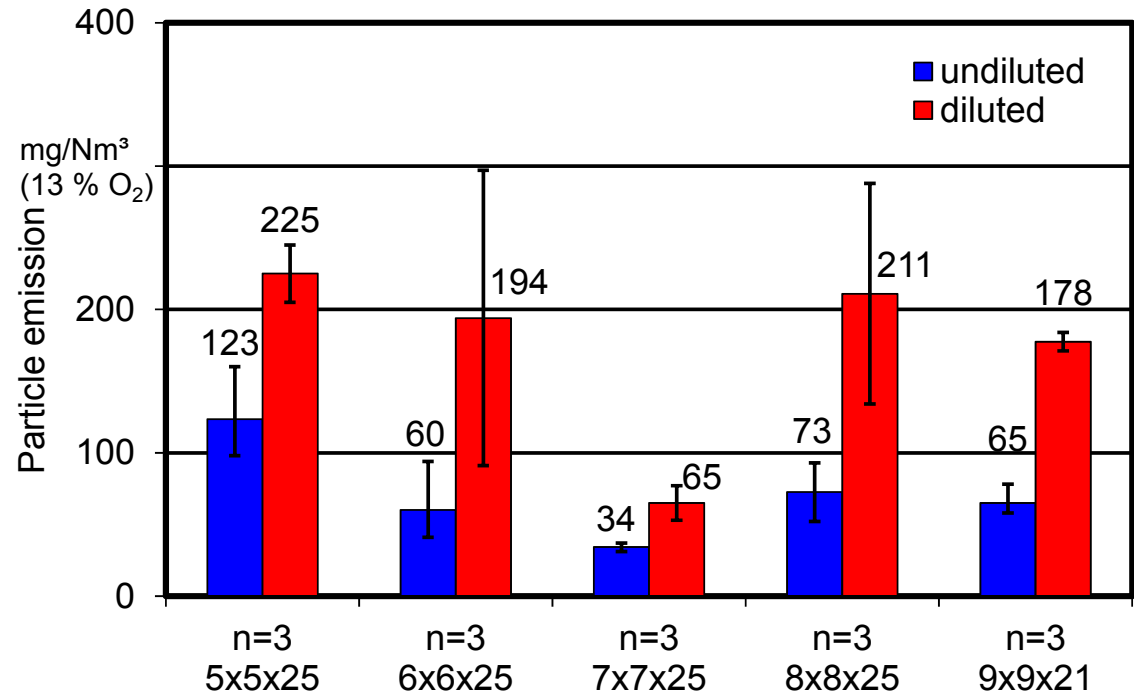
- Recharge when flames are about to extinguish





# Charging with optimal log sizes

- recharge preferably with medium-sized logs
- save small logs for the ignition batches
- combine big logs with smaller ones





# Frequent charging mistakes



Avoid charging with only one big log!



Avoid too long logs!



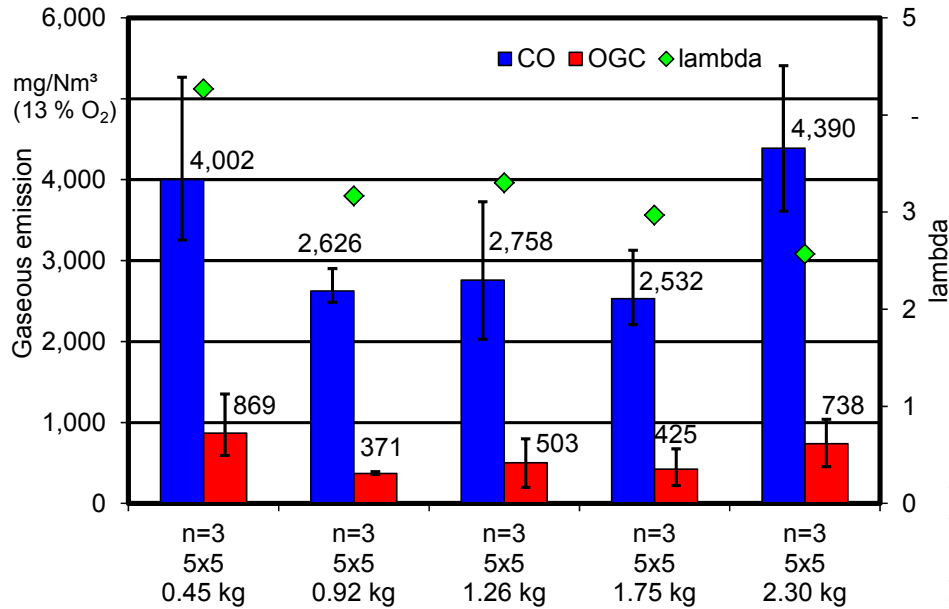
Avoid large space between logs!



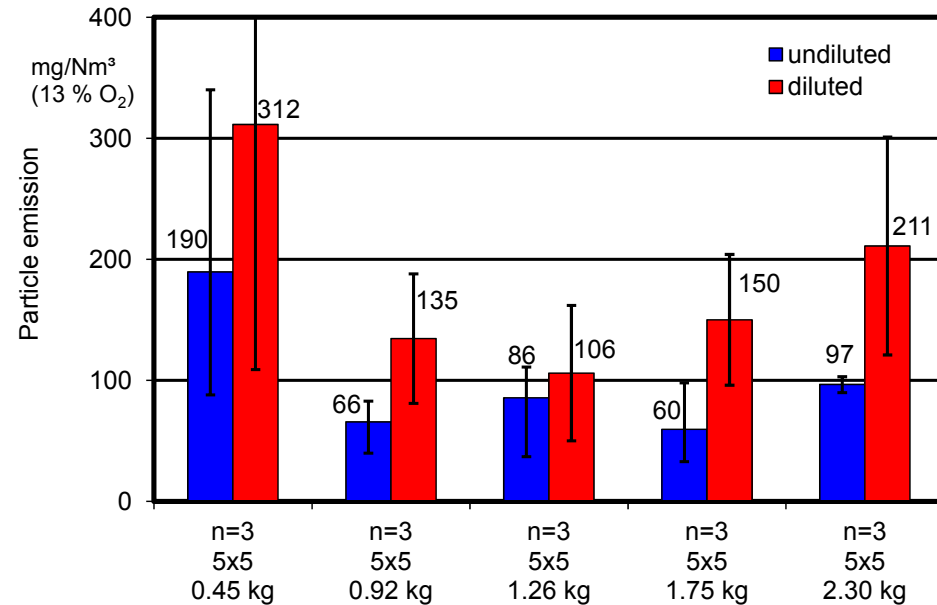
Avoid overloading!

# Fuel mass loading influence: CO and total dust emissions

## Gaseous emissions



## Total particle emissions



Chimney stove, 8 kW



## Fuel charging: briquettes

### Swelling of briquettes during combustion



### Fuel bridge on a bed of amber



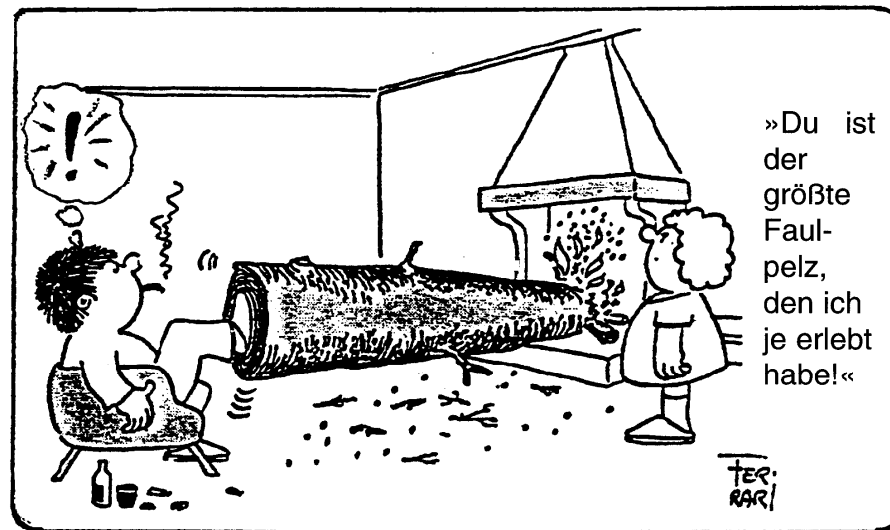
### Risk of bridge formation during combustion:

- The operator shall break briquettes by hand into suitable sizes before charging!



Thanks for your attention!

The complete manual will be provided as download  
on the BE2020 webpage [www.bioenergy2020.eu](http://www.bioenergy2020.eu)



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