



TUESDAY, JUNE 11. 2024
ZLATIBOR

PM10 / PM2.5
WOODCHIPS INCINERATION
WALTER BÄNZIGER

AGENDA



1. INTRODUCTION
2. PM10
3. PM2.5
4. HEALTH HAZARD
5. EMISSION LIMITS
6. EXAMPLE OF AN ENERGY CENTRE
7. DUST MEASURING SYSTEMS (WHEN POSSIBLE)

I . INTRODUCTION



NAME: WALTER BÄNZIGER

AGE: 66

EDUCATION: POSTGRADUATE STUDIES IN ECONOMICS
B.Sc. IN MECHANICAL ENGINEERING
APPRENTICESHIP AS HEATING SYSTEM DESIGNER

BUSINESS EXPERIENCES: SULZER (DH, HEATING SYSTEMS)
BBC (LARGE PP, COMBINED CYCLES)
CHEMAP (FERMENTATIONS)
VON ROLL (INCINERATION PLANTS)
ELECTROWATT (INCINERATION PLANTS, PP)
HUG ENGINEERING (CATALYSTS, SOOT FILTERS)
PÖYRY (INCINERATION PLANTS, PP)
BÄNZ CONSULTING (EW-RECYCLING, INCINERATION PLANTS, PP)

I . INDRODUCTION



WOOD BURNING TECHNOLOGIES

CLOSED FIREPLACES:

HU; MJ/KG; 14.6

EXG-VTR; M³/KG; 9.6

MOIST; %; 25

DUST; MG/MJ; 180



AUTOM. FURNANCES:

HU; MJ/KG; 12.6

EXG-VTR; M³/KG; 9.0

MOIST; %; 33

DUST; MG/MJ; 23



2. PM10 / PM2.5



DEFINITION;

PM10, PM2.5

10

THROUGH

10

PARTICLES WITH AN AERODYNAMIC DIAMETER \leq OF
RESP. 2.5 μm . THESE ARE PARTICLES THAT PASS
AN INLET WITH A 50% SEPARATION EFFICIENCY AT
RESP. 2.5 μm AERODYNAMIC DIAMETER.



AERODYNAMIC DIAMETER

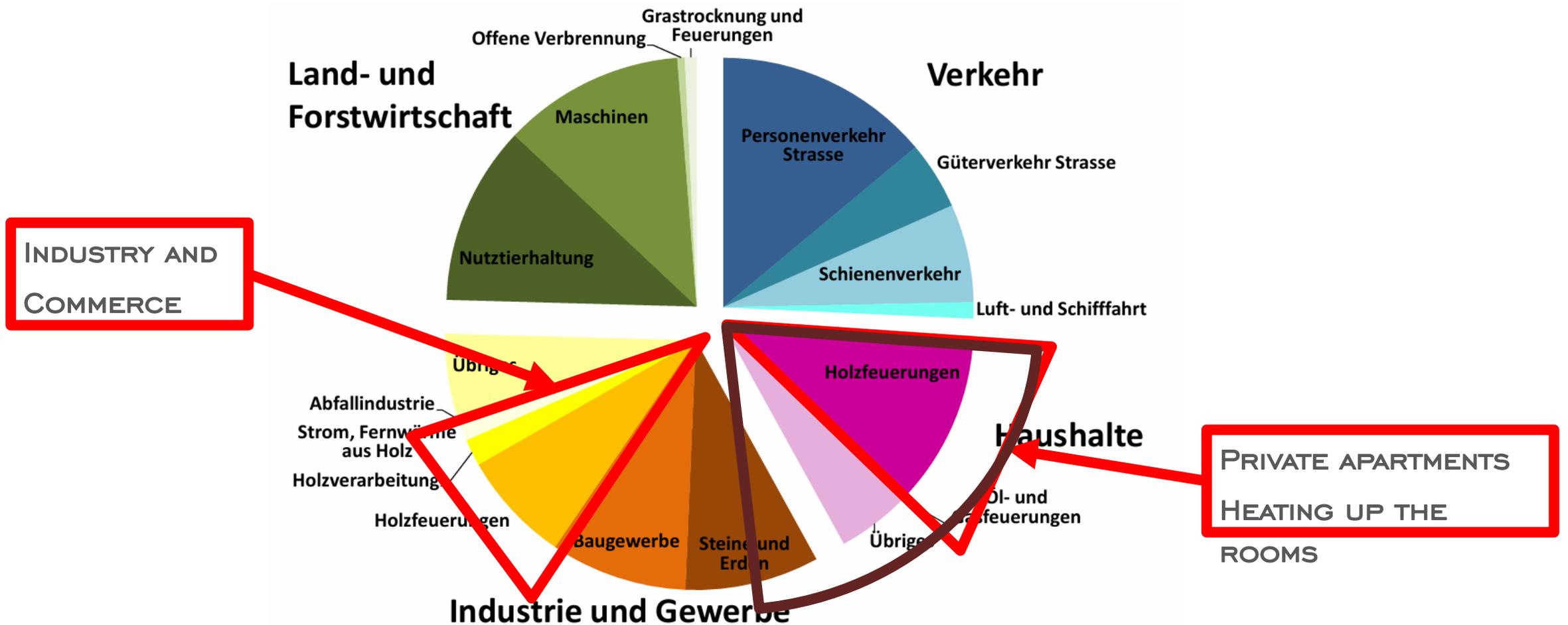
TO

RATE

CORRESPONDS TO THE DIAMETER THAT A SPHERICAL
PARTICLE WITH A DENSITY OF 1 g/cm^3 WOULD HAVE
HAVE IN ORDER FOR IT TO HAVE THE SAME SINKING
IN AIR AS THE PARTICLE UNDER CONSIDERATION.

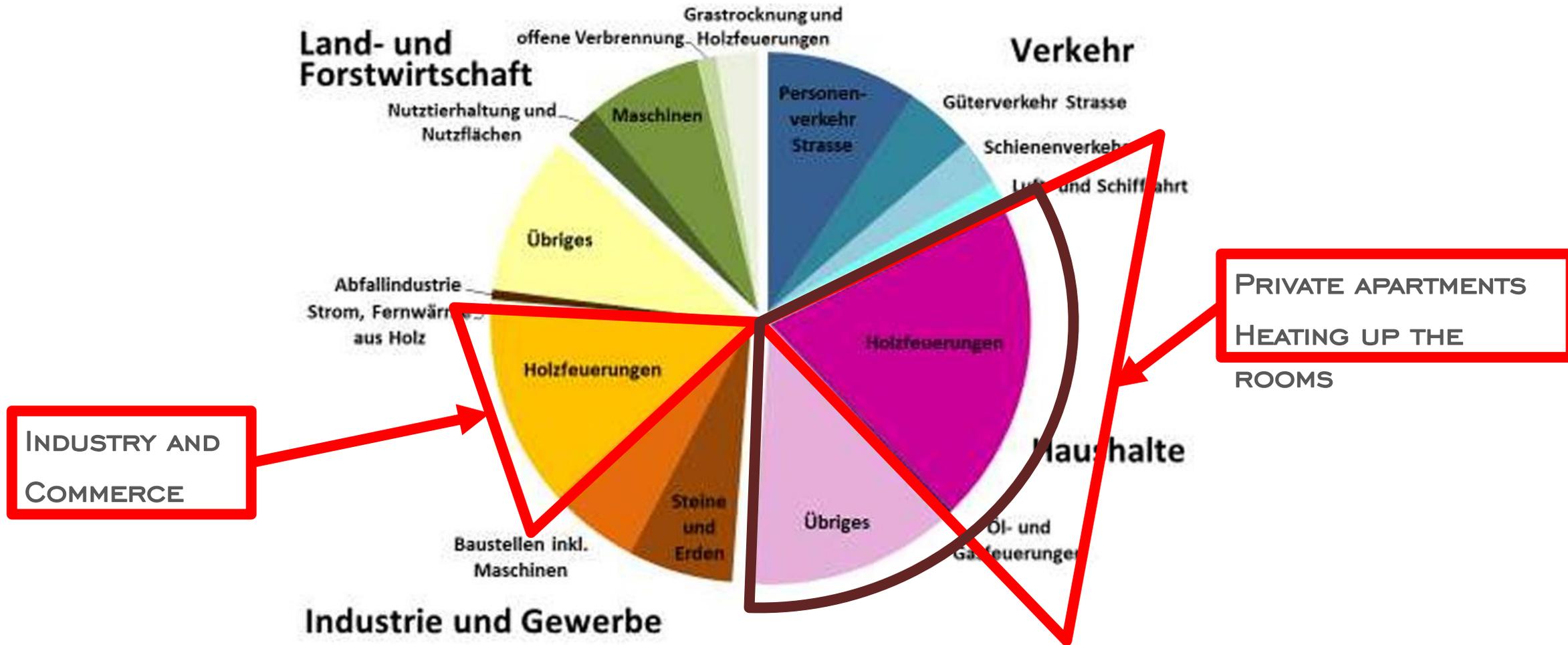
2. PM10

SOURCES OF PM10 IN CH 2010



3. PM2.5

SOURCES OF PM2.5 IN CH 2016



4. HEALTH HAZARD

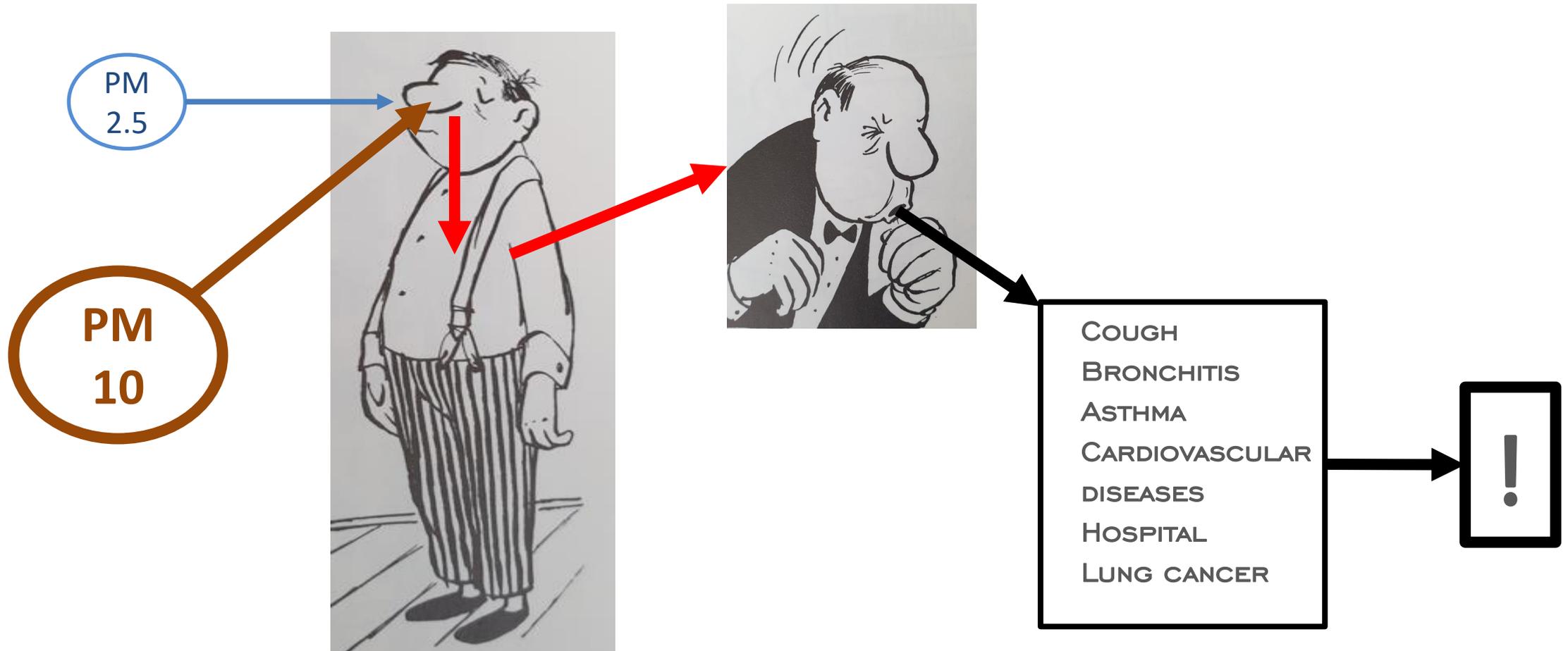
DUST COMPOSITION



PM2.5		
	COMPONENT	PRECURSOR / CAUSE
PRIMARY	SOOT	COMBUSTION PROCESSES
	HEAVY METALS	INCINERATION, PRODUCTION
SECONDARY	SULPHATE	SULPHUR DIOXIDE
	NITRATE	NITROGEN OXIDES
	AMMONIUM	AMMONIA
	ORGANIC MATERIAL	GASEOUS ORGANIC COMPOUNDS SUCH AS NMVOC

PM10		
	COMPONENT	PRECURSOR / CAUSE
PRIMARY	SOOT	COMBUSTION PROCESSES
	HEAVY METALS	INCINERATION, PRODUCTION
	GEOLOGICAL MATERIAL	CONSTRUCTION, AGRICULTURE, TRAFFIC, WIND
	ABRASION PARTICLES	MECHANICAL LOAD
	BIOLOGICAL MATERIAL	FUNGAL SPORES, PLANT FRAGMENTS
SECONDARY	SULPHATE	SULPHUR DIOXIDE
	NITRATE	NITROGEN OXIDES
	AMMONIUM	AMMONIA
	ORGANIC MATERIAL	GASEOUS ORGANIC COMPOUNDS SUCH AS NMVOC

4. HEALTH HAZARD DUST COMPOSITION



5. EMISSION LIMITS



GUIDELINES AND LIMITS

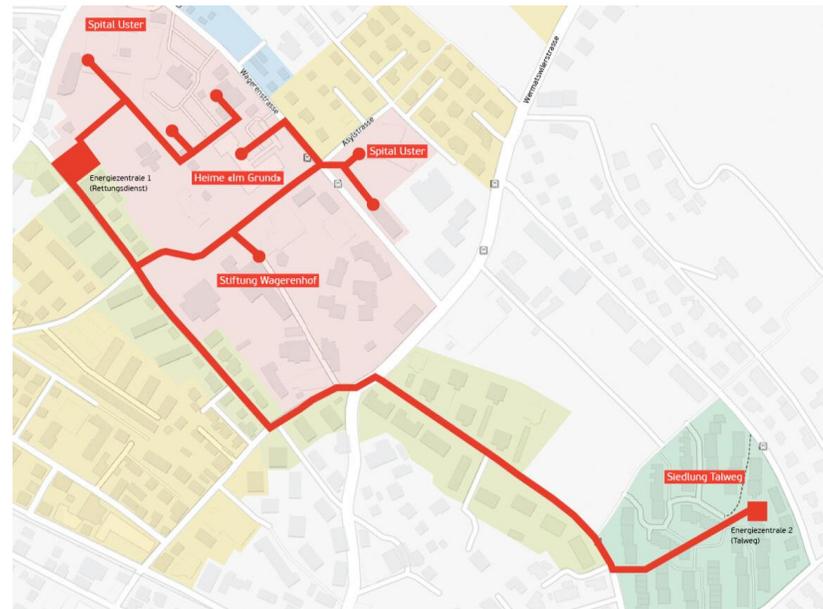
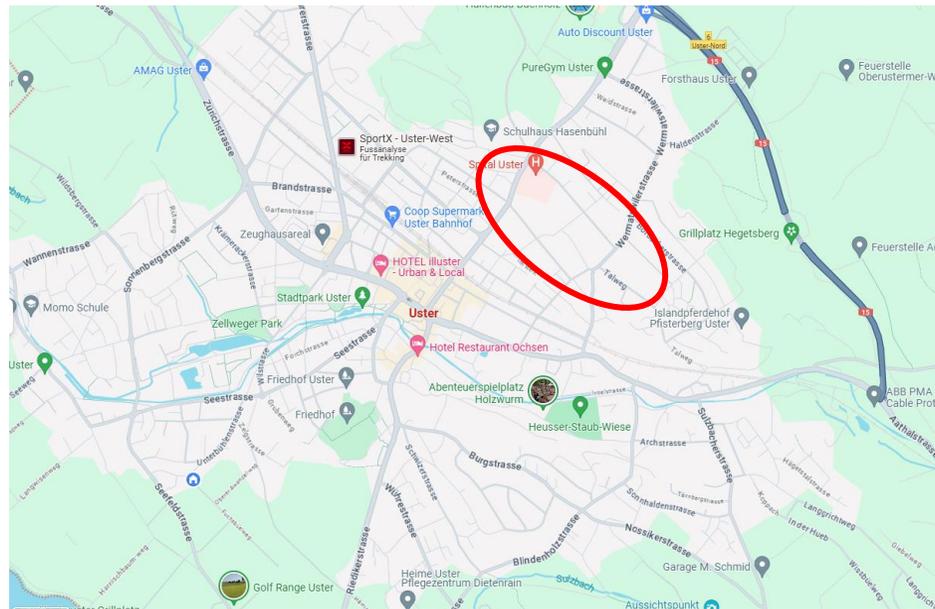
PARTICLES	DESCRIPTION	WHO	EU	CH
		GUIDELINE	LIMITS	LIMITS
PM10	ANNUAL AVERAGE	20 $\mu\text{G}/\text{M}^3$	40 $\mu\text{G}/\text{M}^3$	20 $\mu\text{G}/\text{M}^3$
	DAILY AVERAGE; (3 VALUES PER YEAR MAY BE HIGHER)	50 $\mu\text{G}/\text{M}^3$	50 $\mu\text{G}/\text{M}^3$	50 $\mu\text{G}/\text{M}^3$
PM2.5	ANNUAL AVERAGE	10 $\mu\text{G}/\text{M}^3$	25 $\mu\text{G}/\text{M}^3$	10 $\mu\text{G}/\text{M}^3$
	DAILY AVERAGE; (3 VALUES PER YEAR MAY BE HIGHER)	25 $\mu\text{G}/\text{M}^3$		

6. EXAMPLE OF AN ENERGY CENTRE

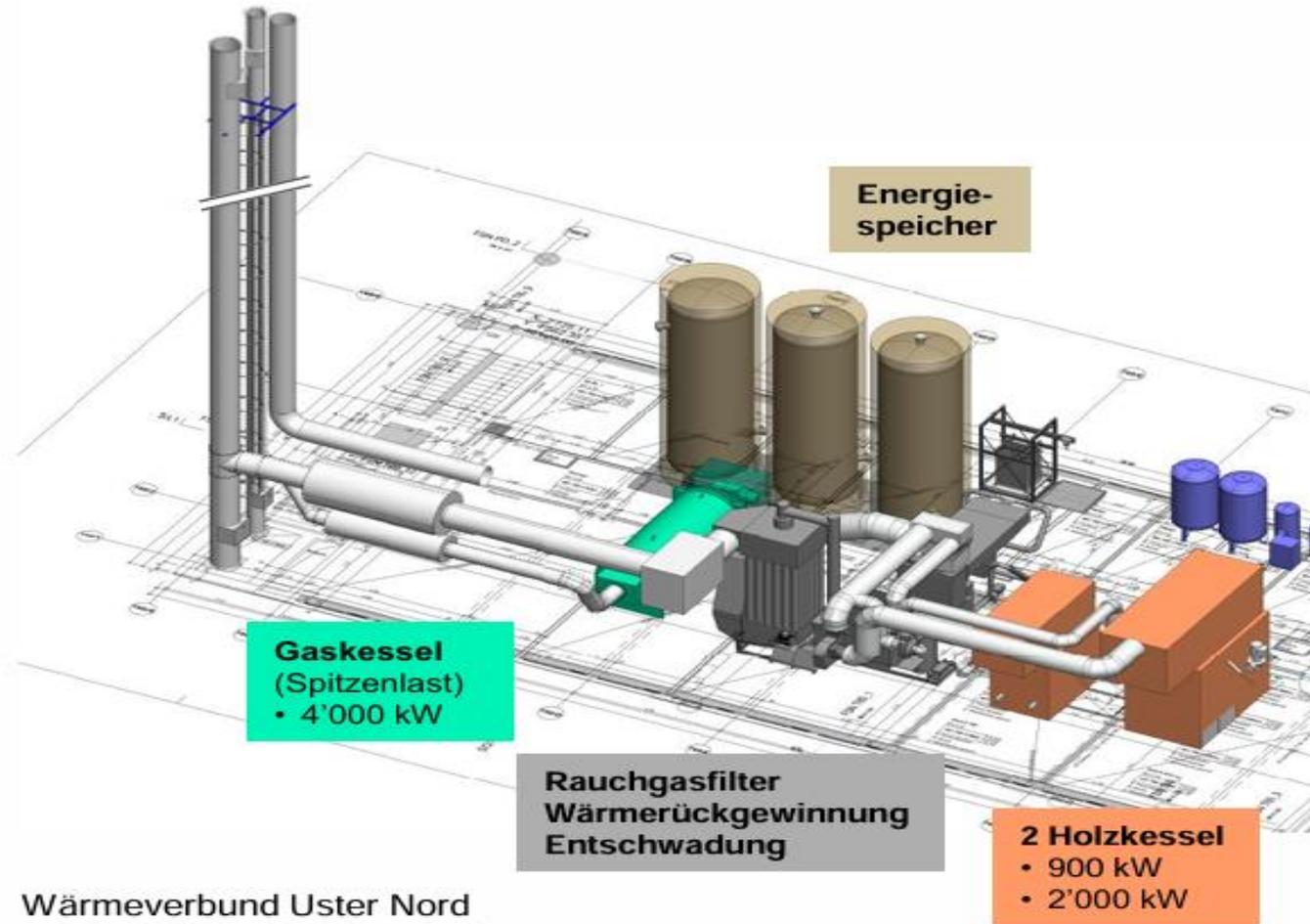


DISTRICT HEATING USTER NORD

- 25 KM AWAY FROM ZURICH
- POPULATION OF ABOUT 37'000
- SMALL DISTRICT HEATING SYSTEM NORTH OF USTER
- ENERGY CENTRE IS AT THE HOSPITAL

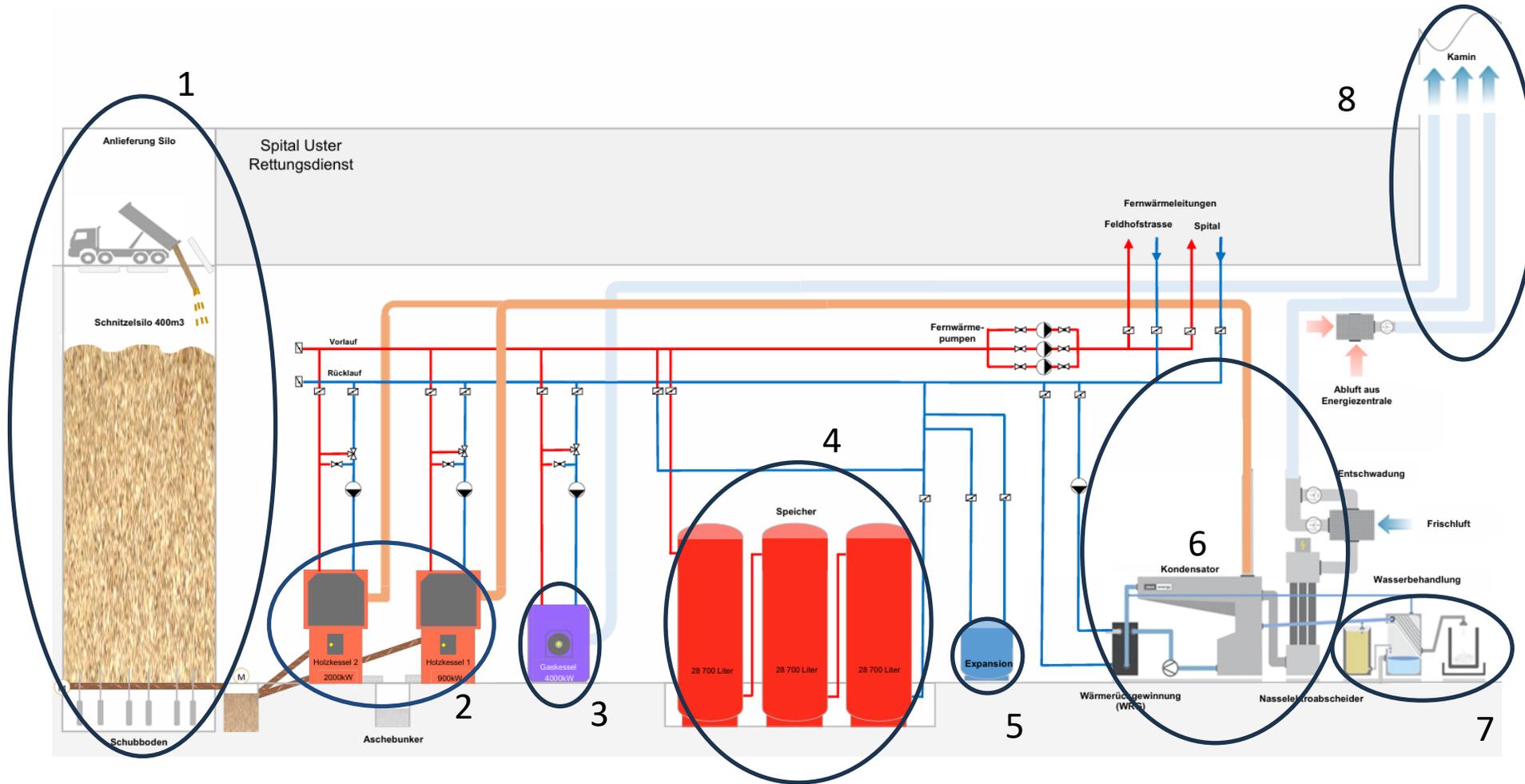


6. EXAMPLE OF AN ENERGY CENTRE ENERGY CENTRE OF USTER NORD



Wärmeverbund Uster Nord
Kundeninformation 04. Juni 2024

6. EXAMPLE OF AN ENERGY CENTRE



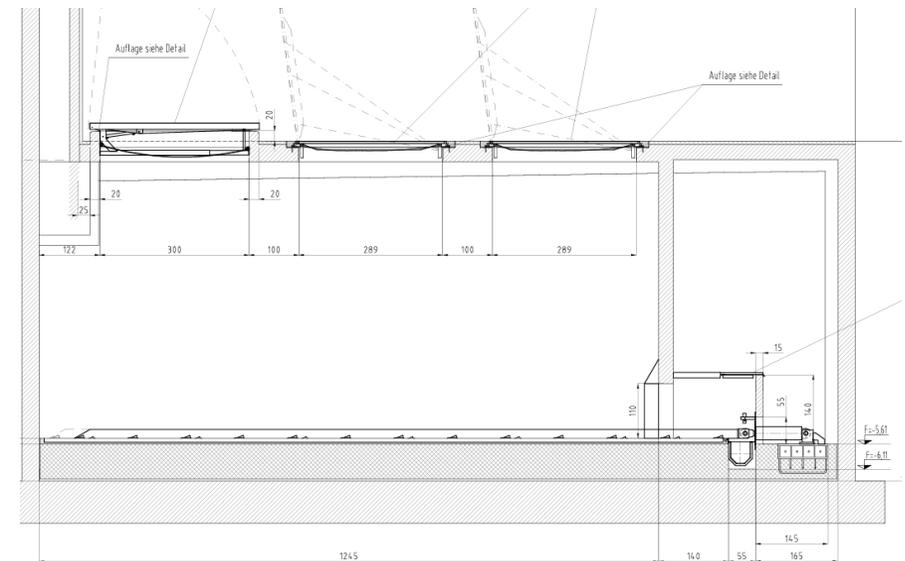
1. SILO
2. WOOD CHIPS BOILERS
3. GAS BOILER
4. WATER STORAGE
5. EXPANSION BOILER
6. EXHAUST GAS PURIFICATION
7. WATER TREATMENT PLANT
8. CHIMNEY

6. EXAMPLE OF AN ENERGY CENTRE



WOOD CHIP SILO:

VOLUME; 400 M³



6. EXAMPLE OF AN ENERGY CENTRE



2 WOOD CHIPS BOILERS:

1 x 2000 kW; (WINTERTIME)

1 x 900 kW; RUNNING ALL THE YEAR

	UNIT	BOILER 1	BOILER 2
HEAT POWER	KW	2000	900
LENGTH	MM	6500	4900
WIDTH	MM	2400	1800
HEIGHT	MM	5100	3600
WATERTANK	L	5600	2400
LOAD TOTAL	T	39.2	17
FUEL	M3/H	3.3	1.4
WATERPRESSURE	BAR	6	6
TEMP. MAX	°C	110	110
TEMP. NOM	°C	75 - 85	75 - 85
TEMP. RETURN MIN.	°C	45	45



6. EXAMPLE OF AN ENERGY CENTRE



EXHAUST GAS PURIFICATION

SNCR (PART OF THE BOILER)



CONDENSER

WET ELECTROSTATIC PRECIPITATOR



PLUME REMOVAL



6. EXAMPLE OF AN ENERGY CENTRE



3 WATER STORAGE TANKS, EACH 30'000

LIT



1 GAS BOILER FOR PICKS OR IN CASE WOOD CHIP BOILERS FAILS

THANK YOU



HVALA NA PAŽNJI

7. DUST MEASURING SYSTEMS

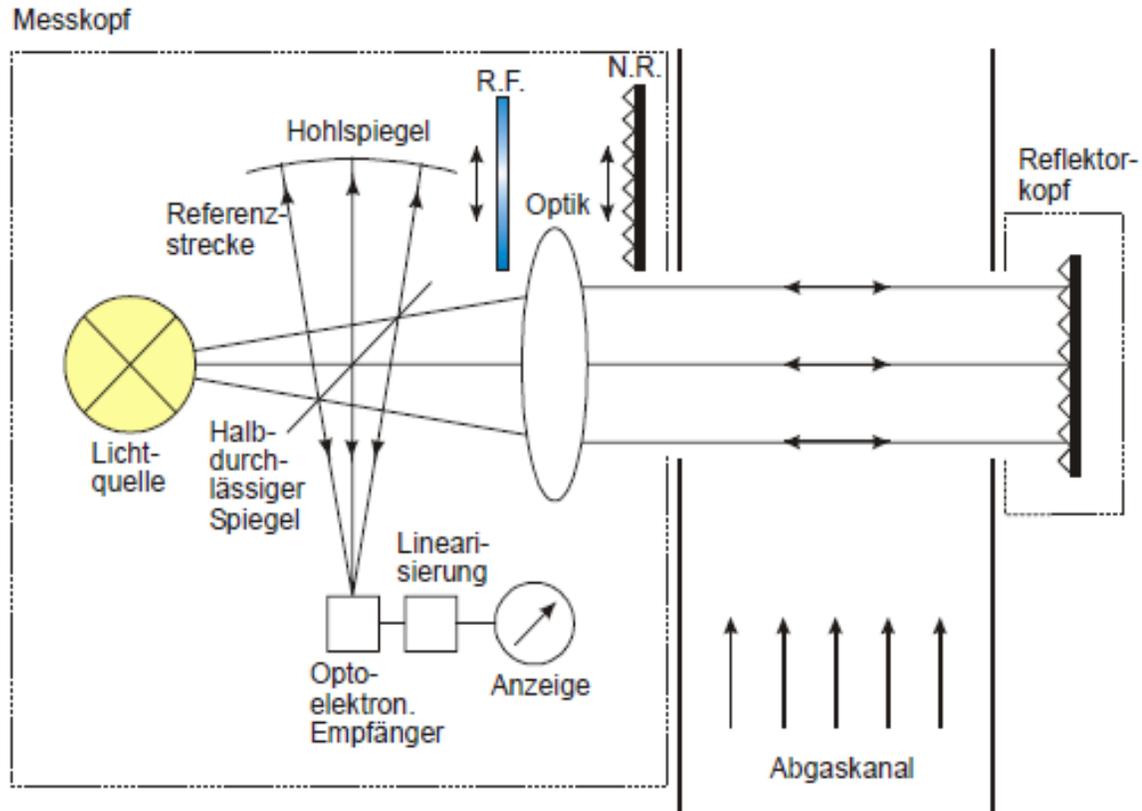


FOLLOWING ARE 2 EXAMPLES OF DUST MEASURING SYSTEMS USED AT INCINERATION PLANTS:

1. PHOTOMETRIC DUST MEASUREMENT
2. SCATTERED LIGHT MEASUREMENT

7. DUST MEASURING SYSTEMS

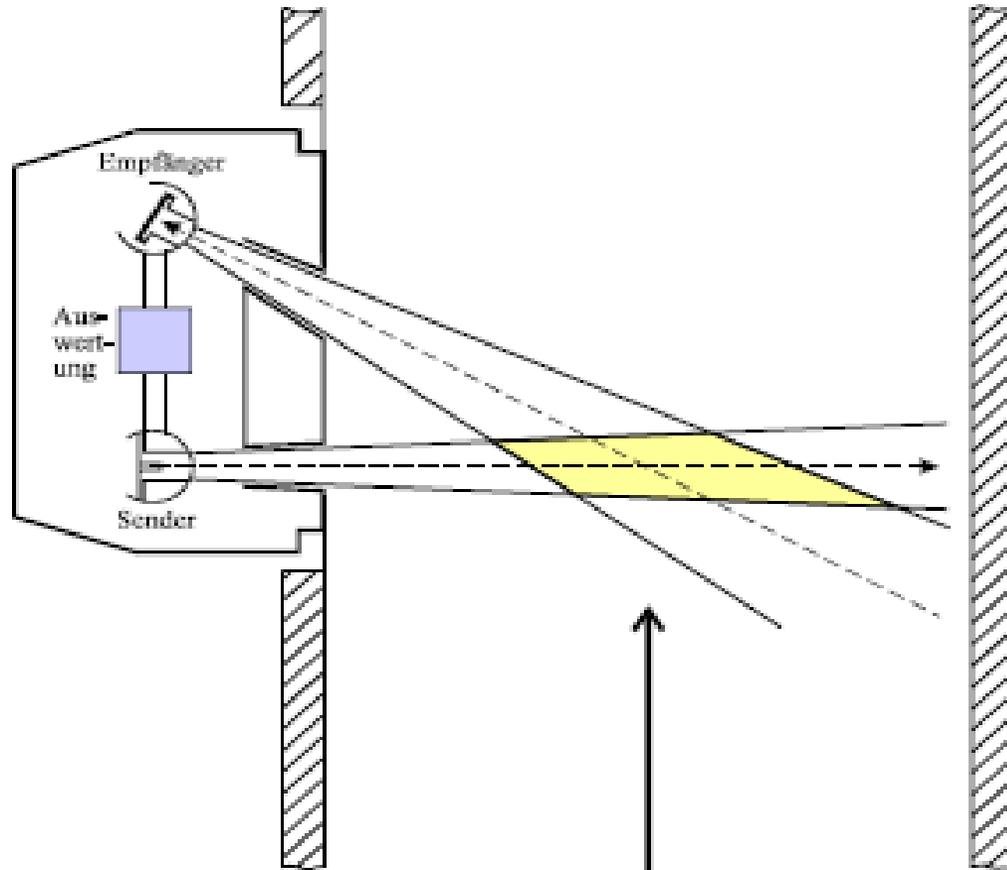
PHOTOMETRIC DUST MEASUREMENT



THE LIGHT EMITTED BY THE LIGHT SOURCE IS DIVIDED INTO A MEASURING BEAM AND A REFERENCE BEAM (DUAL BEAM METHOD). THE MEASURING LIGHT BEAM PASSES THROUGH THE MEASURING SECTION TO THE REFLECTOR AND BACK, THE REFERENCE LIGHT BEAM PASSES THROUGH A DUST-FREE REFERENCE SECTION WITHIN THE MEASURING HEAD. BOTH LIGHT BEAMS REACH THE RECEIVER OUT OF PHASE, WHICH PROCESSES THE SIGNALS AND SUPPLIES AN IMPRESSED DIRECT CURRENT PROPORTIONAL TO THE ABSORBANCE. TRANSLATED WITH DEEPL.COM (FREE VERSION)

7. DUST MEASURING SYSTEMS

SCATTERED LIGHT MEASUREMENT



WHEN PASSING THROUGH A DUST-LADEN GAS, A STREAM OF LIGHT IS ATTENUATED DEPENDING ON THE DUST LOAD AS A RESULT OF ABSORPTION AND SCATTERING BY THE PARTICLES. IN ADDITION TO LIGHT ATTENUATION, LIGHT SCATTERING IS ALSO SUITABLE FOR DETERMINING THE DUST LOADING OF GASES UNDER CERTAIN CIRCUMSTANCES.